THURSDAY, OCTOBER 18, 1900.

THE SUBORDINATION OF THE INDIVIDUAL TO THE WELFARE OF THE SPECIES.

The Foundations of Zoology. By William Keith Brooks, Ph.D., LL.D., Professor of Zoology in the Johns Hopkins University. Pp. viii + 339. (Columbia University Press. New York: The Macmillan Co. London: Macmillan and Co., Ltd., 1899.)

THIS volume forms the fifth of the Columbia University Biological Series edited by Prof. H. F. Osborn and Prof. E. B. Wilson, and it is appropriately placed beside the well-known earlier memoirs which deal with historic, phylogenetic and ontogenetic evolution. The traditions of the series are sufficient warrant for the admirable editing, printing and general appearance of the volume.

The author arranges his work in fourteen chapters corresponding to thirteen lectures, the sixth being divided into two parts. The subjects which follow the introductory lecture are "Huxley, and the Problem of the Naturalist," "Nature and Nurture," "Lamarck," "Migration in its Bearing on Lamarckism," forming the titles of the second, third, fourth and fifth lectures. The sixth deals with "Zoology and the Philosophy of Evolution," and its second part with the views of Galton and Weismann. "Galton, and the Statistical Study of Inheritance" is the subject of the seventh, and "Darwin and the Origin of Species" that of the eighth lecture, the subjects of the remaining lectures being "Natural Selection and the Antiquity of Life," "Natural Selection and Natural Theology," "Paley, and the Argument from Contrivance," "The Mechanism of Nature" and "Louis Agassiz and George Berkely." The titles are quoted in full, inasmuch as it will be recognised that the author's arrangement is unusual, both as regards treatment and the choice of some of the subjects. The same observation is true of the separate lectures: we everywhere meet with interesting views and modes of statement which are individual and original, and evidently represent the deep personal convictions of the author upon subjects to which he has devoted much time and thought. It may be questioned, however, whether the printed lecture is not an inconvenient form in which to address a wider audience than can be gathered in any hall or theatre. The spoken lecture is the best of all forms of communicating ideas, because we have the speaker's personality associated with his thoughts. But the form of a lecture is in large part determined because its substance is conveyed so easily and rapidly by speech and hearing. The same idea must often be repeated in different words, in order that it may be grasped and remembered before passing to others; and an argument may, and often should, be drawn out and enforced at a length which would be unnecessary and even tedious in a printed memoir. The lecturer has the great advantage that he can omit or expand according as he realises the extent to which his audience is in touch with him. When ideas are conveyed in print, the conditions are, of course, entirely different. When the reader does not fully understand, he can pause and reflect, and can read again without losing the sequent ideas. Hence the form can, and should, be far more terse and condensed, and the argument does not need the same enforcement, while the repetition so necessary in a lecture is apt to become irritating.

Allowing for these qualities, which are essential to a lecture, the chapters are most interesting and stimulating.

In estimating the life-work of Huxley, the author rightly places in the foreground the great and successful struggle for intellectual liberty.

"To what nobler end could life be devoted than the attempt to show us how we may 'learn to distinguish truth from falsehood, in order to be clear about our actions, and to walk sure-footedly in this life.' If he has succeeded, and every zoologist who is free to follow nature wherever she may lead is a witness that he has succeeded—if, as the end of his lifelong labour, intellectual freedom is established on a firmer basis—this is his best monument, even if the man should quickly be forgotten in the accomplishment of his end. No memorial could be more appropriate than the speedy establishment of that intellectual liberty which is not intellectual licence on a basis so firm that the history of the struggle to obtain it shall become a forgotten antiquity" (p. 35).

Space prevents further allusion to the interesting criticism of Huxley's philosophy, and the statement of the particular parts of it which have proved to be of the highest value to the author.

"The interminable question whether 'acquired characters' are inherited" is not directly attacked by the author; but it is indirectly attacked in an extremely interesting and effective way. Granted that such inheritance is possible, the author inquires how far it is of value in accounting for the facts of natural history, and concludes that it is of no importance. The third lecture especially deals with this subject, although it recurs in various places throughout the volume. The discussion opens with a most appropriate reference to the teachings of Aristotle.

"Herbert Spencer tells us that the segmentation of the backbone is the inherited effect of fractures, caused by bending; but Aristotle has shown ('Parts of Animals,' I., i.) that Empedocles and the ancient writers err in teaching that the bendings to which the backbone has been subjected are the cause of its joints, since the thing to be accounted for is not the presence of the joints, but the fitness of the joints for the needs of their possessor. It is an odd freak of history that we of the end of the nineteenth century are called upon to reconsider a dogma which was not only repudiated two thousand years ago, but was even then antiquated."

The writer warns us that the tendency of exclusive laboratory teaching may be to lead us to forget Aristotle's principle; and he devotes the whole of this most important chapter to the demonstration, from the discussion of numerous examples, that the problem of fitness is the real problem which confronts the naturalist, and that it is entirely untouched by the explanation of nature as inherited nurture. The chapter concludes with a most convincing reply to the opposing arguments of an English writer. The author unfortunately omits a reference to the publication from which he quotes. The same omission is to be noted in other cases, as in the quotation from Agassiz on p. 16.

In the chapter on Lamarck a powerful argument is derived from "adjustments to the life of other beings than the ones which exhibit the adjustment," such as the poison-fang or sting, which are valuable to the possessor because of their effect on other species. The author finds "the production of adaptations of this sort by the inheritance of the beneficial effects of use, or in any way except by selection, quite unthinkable." Henslow's volume, "The Origin of Floral Structures through Insect and other Agencies" (Internat. Scientific Series) does not appear to be known to the author, although by a few well-chosen examples he shows the futility of the supposed origin which is therein suggested.

"For all I know, the Lamarckian may claim that the visits of insects have, in some way, modified the flower, to its own good, by their mechanical action, by pulling down this part, and by pushing up that, generation after generation, until they have caused adaptive modification in the flower. I do not know how much his ingenuity may be able to make out of this hypothesis; but no one can believe that the hooks and spines, which are so obviously adapted for distributing burrs and seeds, by fastening them to the fur of passing mammals, have been produced by the inheritance of the effects of this sort of mechanical contact; for these structures do not come into use until they are dead; and, most assuredly, dead things cannot transmit 'acquired characters' to their descendants. When a drop of rain or dew falls on the dead, dry, twisted glume of the animated oat (*Avena sterilis*), it untwists in such a way as to push like the leg of a grasshoper, and, raising the seed, to send it off with a jump. After the seed has fallen, this process is repeated again and again, until the heavy end, where the seed is placed, falls at last into some roughness in the ground, when the glumes begin to kick and to struggle, and, catching in the grass and roots, or on the rough ground, to push the seed down and to plant it. The seed is alive, but the glumes are dead and dry, and as completely out of the line of descent to future generations as the dead leaves which drop from the tree."

This quotation illustrates the very effective manner in which the Lamarckian principle is dealt with. In certain striking cases it is shown to be obvious that the hypothesis of Lamarck *cannot* supply an explanation, while selection offers a probable solution. At first sight these examples may appear to be exceptional and rare, but the author shows us that

"all the adaptations of nature are of this sort. *In all cases*, the structure, habits, instincts and faculties of living things, from the upward growth of the plumule of the sprouting seed to the moral sense of man, are primarily for the good of other beings than the ones which manifest them."

In support of this conclusion, the evidence of "the insignificance of the individual, as compared with the welfare of the species" is marshalled and illustrated in a peculiarly convincing and striking manner. Of all the examples, the most wonderful is certainly that of the queen-bee in her relation to the other members of the royal family and to the hive. A hive requires a queen, but would be disorganised by the presence of more than one queen at the same time. Until the queen-mother has led out a swarm, the workers will not permit a young queen, although mature, to leave her cell. In order to preserve her from the reigning queen, she is walled up with layers of wax and fed through a small opening. When swarming has occurred, a young queen is allowed to escape: she in her turn is impelled to kill the rest of the royal brood, but is prevented by the workers. Later on in the season, however, when it is no longer possible to swarm, the attitude of the workers entirely changes, and they now "incite her to destroy her rivals." And here we meet with a most wonderful adaptation. It is obvious that any royal larva may, under certain circumstances, benefit the hive by producing a reigning queen, or, on the other hand, under different circumstances, may be killed in order to prevent a danger to the community. The instincts of the royal larva are such that it prepares beforehand for the latter alternative, and facilitates its own murder without inconvenience or danger to the queen, by spinning an incomplete cocoon which exposes the soft abdomen to the sting. Darwin pointed out in the "Origin of Species" that the social Hymenoptera afford the most complete evidence of instincts which cannot be due to use-inheritance inasmuch as they are exhibited by the sterile workers, the offspring of drones and queens with quite different instincts. Brooks has used the same example with great effect to emphasise "the supreme importance of the species, and the relative insignificance of the individual." Darwin's conclusion is also put with remarkable force on p. 95. This most interesting and convincing chapter concludes as follows:

"Some may ask whether it may not be possible that while natural selection is the chief factor in the origin of species, there may still be a residuum to be accounted for by the 'inheritance of acquired characters.' For all I know this may be not only possible, but actually the case. I have never felt the slightest interest in *a priori* demonstrations of the impossibility of this sort of inheritance; and for all I know to the contrary, proof of its occurrence may be found at any time, although I know no good evidence of its occurrence. I had satisfied myself, long before the recent revival of interest in the matter, that whether it be a real factor or not, the so-called Lamarckian factor has little value as a contribution to the solution of the problem of the origin of species; and renewed study has strengthened this conviction."

It must be remembered, on the other hand, that such inheritance would require an inconceivably elaborate mechanism, which can hardly have arisen and been sustained in order to account for a factor which is of little value in evolution.

"Migration in its bearing on Lamarckism" is the title of the succeeding lecture. The same subject was treated of in one of the most fascinating of Wallace's classical essays upon natural selection. It is interesting to compare the two, and to recognise how very greatly the interpretation of this difficult problem has been elucidated by the younger zoologist. Wallace dwells upon the lines of bird migration in their relation to past geographical change, and to the special need for insect food during the breeding season. Brooks treats the problem as a part of the wide principle of the subordination of the individual to the welfare of the species; he doubts the dependence on geological change and the great importance of food, and makes the illuminating suggestion that security from the enemies of eggs and young is the controlling factor alike of bird and fish

migration, and he dwells on the risk to parents involved in the process.

"Long journeys are hazardous. Every Californian salmon which enters upon the long journey to the breeding ground is destroyed, and the whole race is wiped out of existence for the good of generations yet unborn. Very few shad ever return to the ocean, and storm and accident and ruthless enemies work their will on the migrating birds and decimate them without mercy; yet the dangerous return to safe breeding grounds still goes on, in order that children which are yet unborn may survive to produce children in their turn."

Want of space prevents any further criticism of this most interesting volume. Enough has been said to prove that all the lectures demand the serious consideration of every student of evolution.

It is a peculiar pleasure to the British naturalist to find the Darwinian principle illustrated and defended with such remarkable force and success by a distinguished American zoologist. E. B. P.

A MODERN TEXT-BOOK OF OPTICS.

Lehrbuch der Optik. Von Dr. Paul Drude, Professor des Physik au des Universitat Giessen. Pp. xiv + 498. (Leipzig: Verlag von S. Hirzel, 1900.)

PROF. DRUDE'S name is well known to English physicists. As a careful and exact worker, the author of a book on the Physics of the Ether, and the successor of Gustav Wiedemann in the editorship of the *Annalen des Physik*, he has already made a high reputation for himself, and the book now under consideration will serve to add to it. Text-books of optics, it is true, are numerous, and the reviewer is apt to think that of the making of many books there is no end. Prof. Drude's book, however, contains much that is novel—at any rate, to English text-books—and the student will find up-to-date information on many points of interest.

In some respects the book has much in common with the late Prof. Preston's well-known text-book; it gains, however, in the end as a treatise on the subject by the definite adoption of the electromagnetic theory, although it is, of course, in consequence, less complete in that it gives no account of elastic solid theories.

The first hundred pages deal with geometrical optics. After a clear statement of the fundamental laws, including the law of the minimum path, and Malus' law of orthotomic systems, we have a chapter on the geometrical theory of optical images. A definition of an optical image is given; it is then shown that the image of a plane is a plane, and hence the analytical relation between the position of a point and its image is found. From this, following Abbé and Czapski, the geometrical theory of a perfect image is developed clearly and concisely. Throughout this part the book runs on similar lines to Dr. Moritz von Rohr's "Geschichte des Photographischen Objectivs," recently reviewed in these pages (NATURE, vol. lxi. p. 511), though, of course, the more technical part is dealt with much more briefly than in Dr. von Rohr's book.

Further chapters deal with the formation of images by real rays and the effects produced by the limitations in the size of the pencils in the case of actual instruments. The chapter on optical instruments is perhaps rather brief, but it is not the main object of the author to describe these. Throughout this part the book is very different from anything yet published in English, and will well repay study; it is interesting to read and clearly written; at the same time, it is commendably brief, and contains little long or cumbersome analysis.

The remaining four hundred pages are devoted to physical optics. In the first section of this, which deals with the general properties of light, there is, with one exception, nothing particularly novel. The treatment of interference, diffraction, the geometrical theory of double refraction and the colours of polarised light follow the usual lines; it could hardly be otherwise. The whole is brought up to date, however; there is, for example, an excellent account of Michelson's echelon spectroscope, while the theory of the resolving power of an optical instrument is given in some fulness; it is all well done, though the English reader will not find much to make him prefer the book, as a text-book, to Preston. The one exception is the chapter on Huyghens' principle. In his elementary discussion on the rectilinear propagation of light, Dr. Drude makes a distinct step by adopting the methods given by Dr. Schuster (*Phil. Mag.*, vol. xxxi. 1891), while he completes the discussion by giving Kirchhoff and Voigt's solution of the problem of finding the disturbance at a given point due to disturbances existing at some previous time over a surface surrounding the point. To do this, he has, of course, to make use of the differential equation satisfied by the disturbances, and this is not found till a later stage in the book; but the student who has read sufficient mathematics to follow the proof will probably be acquainted with the fact that the differential equation quoted does represent wave motion, and will not find any logical difficulty in the order adopted, while the proof will put the whole theory of diffraction before him on a sounder basis. An English reader, however, who realises what he owes to Stokes in this matter, may be allowed to express surprise that there is no reference in Prof. Drude's work to the great paper on the dynamical theory of diffraction, published in 1849 in the ninth volume of the *Transactions* of the Cambridge Philosophical Society.

The second section of this part deals with the optical properties of bodies, and here the distinctive points of Prof. Drude's method show themselves. After a brief reference to the elastic solid theory of the ether and the difficulties to which it leads, he adopts formally the electromagnetic theory.

The optical disturbance at any point through which light-waves are passing can be represented by the periodic variations of a vector quantity, the light-vector, as Drude calls it, and in a transparent isotropic medium this vector follows the same laws as do the electric or magnetic force in an insulating body. The electromagnetic theory of light identifies the light vector either with the electric or the magnetic force. Drude adopts the first of the two alternatives.

In an æolotropic medium, a third vector, the rate of change of the electric displacement, or the electric current, needs to be considered—in an isotropic body this coincides in direction with, and is proportional to

the electric force. For reasons which are stated, however, in a crystal, this third vector, the electric current, is taken to represent the light vector. The consequences of this theory are then worked out fully. The general equations of the electromagnetic field are obtained from the two laws (1) that the work done in carrying a unit magnetic pole once round an electric current i is $4\pi i$; and (2) that the work done in carrying a unit quantity of electricity once round a magnetic current j is $4\pi j$.

The phrase magnetic current is perhaps not a very common one, though some English writers have used it. The magnetic current multiplied by 4π is equal to the rate of change of magnetic induction; thus the second law is merely Faraday's law of induction of electric currents.

In forming the equations care must be taken to measure throughout in the same units, electrostatic or electromagnetic, as the case may be. Prof. Drude assumes that electric inductive capacity and permeability have no dimensions and introduces a quantity, which he tells us is of the dimensions of a velocity and equal to the velocity of light, as representing the ratio of the units. The same result would have been reached more simply by introducing two symbols, κ_0, μ_0, of unknown dimensions to represent the inductive capacity and permeability of a vacuum, and then showing that $1/(\kappa_0\mu_0)^{\frac{1}{2}}$ was of the dimensions of a velocity.

From the equations thus found, together with the known electromagnetic laws expressing the action which takes place at the common surface of two media, the laws of transmission, reflexion and refraction in isotropic and crystalline transparent bodies can, as is well known, be deduced so long at least as we avoid phenomena of dispersion. They lead to Fresnel's sine and tangent laws for reflexion, and these in reality are not accurately satisfied; but it is shown that the small amount of elliptic polarisation observed can be accounted for by the supposition that the transition across the interface is not sudden. On this point a reference to a paper in the *Phil. Trans.* for 1894, Part ii., by G. A. Schott, would not have been misplaced. In fact, we may say that so long as the difference between the properties of a refracting body and those of the ether can be completely expressed by a change in the inductive capacity, the simple equations of the electromagnetic field suffice for the co-ordination of optical effects; but when this is no longer the case, when the supposition of a mere change in refractive index is not sufficient to express the action of the matter upon ether, modifications in the equations which can not be entirely justified by reference to known electromagnetic laws become necessary. Absorption and dispersion, aberration and the action of magnetism on light require further hypotheses for their explanation, and the part of the book in which Prof. Drude deals with these and cognate phenomena is of great interest.

The phenomena of absorption and of metallic reflexion are explained by the hypothesis that absorbing media are conductors like the metals.

The total current in such media is composed of two parts, that of displacement or polarisation depending on the rate of change of the electric force, and that of conduction proportional to the force. From this it follows that in the equation for a component of the electric force, X, for example, a term in $a\mathrm{X}/dt$ appears; we have a viscous as well as an elastic resistance to the motion.

Prof. Drude points out, as Lord Rayleigh had done nearly thirty years before (*Phil. Mag.*, 1872), that the numerical results derived from experiments on the metals cannot be reconciled with such a simple theory; it needs modification, and the direction of the requisite change is indicated by the theory of dispersion which is discussed next.

Up to this point the theory has not been mechanical. We know from purely electrical observations the laws of electromagnetic force without needing to know the mechanism, ætherial or material, to which that force is due. Changes in the electric force give rise in a dielectric, to an electric current, Maxwell's displacement current, and the laws obeyed by this current in transparent bodies are exactly those of light.

The light vector may be electric displacement, or it may be some periodic change in the ether, *e.g.* a twist or a displacement of the ether particles, which obeys exactly the same laws as electric displacement; we do not know, and, so far as the theory is concerned, we do not need to know, which of these hypotheses is true.

When we are dealing with the action of matter, however, it becomes necessary to introduce some mechanical conceptions. Thus Prof. Drude, following von Helmholtz, supposes that the molecules of a dielectric are composed of charged ions which are set in motion by the electric force when a train of light waves traverse the medium. The current in this case across any section is made up of the displacement current, together with the convection current due to the displacement of the ions; thus a new variable, expressing the displacement of the matter, is brought into Maxwell's simple equations. In consequence a new set of equations, determining the motion of the ions, become necessary.

Now, the external force on an ion will be proportional to its charge and to the electric force. Drude supposes that, in addition, its motion is retarded by a force proportional to its displacement, and by a frictional force. Of course, since we are dealing only with harmonic motion, this is merely equivalent to saying that the force of restitution can be expressed by a series of harmonic functions. In this way equations are obtained similar to those given by Sellmeyer's mechanical theory—a theory, as Lord Rayleigh has recently shown, originally due to Maxwell—from which the phenomena of dispersion can be deduced. The same hypotheses serve to overcome the difficulties of a theory of metallic reflexion based on conductivity.

Fairly obvious modifications of the equations of motion of the ions lead to explanations of the rotatory polarisation of sugar and quartz. The action of magnetism on light is more complex; it is deduced from an hypothesis of molecular vortices. The ionic charges are supposed to be in a state of rotation about the lines of magnetic force, and the consequences of this on the equations of motion are examined. This leads to a rational explanation of the magnetic rotation of the plane of polarisation, and of the Hall effect, while in another section the Zeemann effect is touched on. The last chapter of the

section deals with aberration; it is supposed that the ether in a moving body remains, so far as the motion of the body is concerned, at rest. Thus another term has to be added to the expression for the current; the ions are carried with the body, and give rise to a convection current.

This assumption appears, however, open to criticism. Since the total charge in any element of volume is zero, the total convection current due to the motion of that element, as a whole, must also be zero. The case differs from that in which the oppositely charged ions are set in motion in opposite directions by electric force. The fact that the axes to which we refer the relative motions of the ions are themselves in motion, introduces new terms into the equations which are sufficient to account for aberration without assuming the existence of this convection current.

The consequences of this relative motion are examined, following H. A. Lorentz, to whose labour on this subject so much of our knowledge is due, and an explanation given of aberration and of Fizeau's celebrated experiment on the effect of moving water on the velocity of light.

In all this work Prof. Drude has been most successful; the electromagnetic theory, supplemented by the one additional hypothesis of the moving ions, serves to co-ordinate in a satisfactory way very many of the phenomena of light.

Further knowledge may modify our views, but up to the present Prof. Drude's book contains the most rational account of the phenomena of optics which we possess; it is a book which should be read by all students, and he is to be congratulated on having written it.

And now having said this, in conclusion a grumble and a suggestion may be permitted. There is no index, and though the table of contents is a full one, this can never replace an index. Again, the book would be more interesting and more valuable, and would give a fairer account of the subject, if the references to original papers, especially papers published some time back and in other countries besides Germany, were more complete. A second edition will be called for before long. Will Prof. Drude increase the gratitude due to him for his work by remedying these two defects?

AGRICULTURAL EDUCATION IN THE UNITED STATES.

Year-book of the United States Department of Agriculture, 1899. Pp. 880; 63 plates. (Washington: Government Printing Office, 1900.)

THE present volume is a special one, the Secretary of Agriculture desiring "that the Year-book for 1899, the distribution of which will occur during the last year of this century, shall present to the reader a picture of the development of agriculture in the United States during the nineteenth century, and of its condition at the present time." The volume contains twenty-six reports, from the various bureaux and divisions under the Department of Agriculture. These reports are followed by an appendix giving particulars respecting the various agricultural organisations now at work in the country. The whole is copiously illustrated.

The various reports on the development of knowledge and of work during the past century are of course written in a popular style, being primarily intended for the information of the general community in the United States; we must not, therefore, expect to find in them much exact science. They are, nevertheless, of great permanent value, and should be carefully studied by all those who desire that the agriculture and the agriculturist of Great Britain should exhibit the rapid progress in improvement which this volume shows to be taking place on the other side of the Atlantic.

As the subject of agricultural education is now occupying the public mind in England, it will perhaps be of service if we briefly mention what is at present being done in America, as set forth in the volume now before us.

The Report dealing with education informs us that the attempts to introduce instruction in agriculture into elementary rural schools have failed. Now, however, a hopeful movement has been started by the College of Agriculture at Cornell University, and taken up by some other State colleges, for the introduction of "nature studies" into elementary schools. To accomplish this object leaflets containing suitable matter for lessons have been issued, and model lessons are given in the schools by travelling inspectors. The first difficulty to be surmounted is, in fact, the teaching of the teachers. Up to the present time little has been done toward the establishment of second grade agricultural schools, and agricultural subjects are not as yet taught in the High Schools.

In America, the State College or University, with the Experiment Station attached to it, have been the prime movers in agricultural education. The colleges have by no means confined their work to their own students, but have actively carried on a large amount of external teaching of various kinds. Thus, besides the full course of instruction, lasting two or four years, provided for the members of the college, short winter courses of twelve weeks' instruction are in many cases provided for the special requirements of young farmers, and in some States these short courses have been very successful. The staff of the college and experiment stations also do much good by lecturing at farmers' institutes. These institutes will meet for a session of three days in various places, the time being occupied by a series of papers and discussions. It is estimated that about 2000 of these meetings were held in the United States during 1898, attended by half a million farmers. In Wisconsin the best papers are issued as an annual volume, 60,000 copies of which are distributed, one being placed in the library of every elementary school. The practical influence of these institutes has been very great. Several State colleges have also commenced correspondence classes in agriculture, and have enrolled a large number of readers who receive assistance and advice from the college. The influence of the experiment stations has also been very great; their investigations have produced a local interest in the study of agricultural problems, and afforded examples of the aid which science can render to the farmer. Without the work of the station the teaching of the college would have appeared academic and theoretical, and would have failed to commend itself to the practical man. The

farmer's bulletins issued by each experiment station, and distributed post-free throughout the State to every farmer asking to receive them, are of considerable educational value. The work of all the State colleges and experiment stations is unified by the Association of American Agricultural Colleges and Experiment Stations. This Association consists of delegates appointed by the colleges and stations, and by the United States Department of Agriculture, and meets for several days once a year to hear reports and discuss methods of work. The Association has permanent executive committees, which carry out the work initiated by the Association.

Although both colleges and experiment stations are State institutions, they are more or less under the influence of the National Department of Agriculture, as every institution receives annual grants from Government funds, for the proper use of which the Department of Agriculture is made responsible. The United States Department of Agriculture is on a very large scale; the sum appropriated to its use by Congress in 1899 was 2,829,702 dollars. It includes many sub-departments, provided with a numerous staff of scientific workers. It has excellent laboratories, a botanic garden, museum and library containing 68,000 volumes, three-quarters of which are on agricultural subjects. It undertakes investigations of all kinds. It publishes in the *Experiment Station Record* summaries of all the work done by the experiment stations. The publications it issues for gratuitous circulation are most voluminous, and embrace all subjects with which it is thought the farmer or student should be acquainted. In 1899, 26,420 pages were published, and 7,075,975 copies printed. Of the present year-book the edition is 500,000 copies, with 20,000 extra copies for the Paris Exhibition.

We have already mentioned the sum annually spent by Congress on the Department, we may conclude by saying that the annual income of the State agricultural and mechanical colleges is stated in the year-book to be 6,008,379 dollars, while the income of the experiment stations amounts to 1,143,334 dollars. Such is in brief the provision made in the United States for the improvement of the science and practice of agriculture in the country. R. WARINGTON.

OUR BOOK SHELF.

Lehrbuch der Anorganischen Chemie. Von Dr. A. F. Holleman. In gemeinschaft mit dem Verfasser bearbeitet und herausgegeben von Dr. Wilhelm Manchot. Pp. xii + 440. (Liepzig: Veit and Co., 1900.)

THIS is an advanced text-book of inorganic chemistry, distinguished from others chiefly by the embodiment in it of chapters of modern physical chemistry. The book, indeed, gives the impression of having been produced by shuffling the detached chapters of two others—one, an ordinary treatise on inorganic chemistry, the second on physical chemistry.

It is almost impossible to discern the system which has guided the compilers. The book begins with some generalities about the scope of science, and the differences between physics and chemistry. It then proceeds to describe some chemical operations, such as dissolving, filtering and distilling. This is done in language suitable for children, and illustrated by two diagrams, in one of which a filter paper is seen to project considerably above the rim of the funnel. The elements having been named, oxygen is next described—such terms as critical temperature being taken as understood by the reader, who has just been told how to separate salt from sand. After a description of hydrogen, the indestructibility of matter is discussed, and then comes water. The laws of chemical combination and the atomic theory occupy the next few pages, then chlorine and its compounds. We now come upon the laws of Gay Lussac and Avogadro, ozone and hydrogen peroxide, then modern methods of determining molecular weights, with a discussion of semi-permeable membranes. And so the book proceeds. Dissociation is discussed between iodine and fluorine, electrolytic dissociation between the halogens and sulphur, the phase rule under sulphur, thermochemistry, including thermodynamics between sulphur and nitrogen.

It is impossible to say anything in praise of this arrangement or want of arrangement. It can hardly be defended on logical or didactic grounds, and one is tempted to think that there is nothing more than a striving for novelty at the bottom of it.

The book does not aim at teaching how chemists do their work, discover facts, and establish theories; and surely if it were desired to present descriptive inorganic chemistry on the basis of the general theories of modern physical chemistry, it would have been better to have begun with an account of these theories and to have woven them into the descriptive part throughout.

Whilst speaking thus of the general scope of Prof. Holleman's book, it is right to add that in detail there are features that call for commendation. The descriptive part is well abreast of the times, and many of the intercalated chapters on physical chemistry are clearly and concisely written. A concluding chapter summarising Werner's voluminous papers on the metal-ammonium compounds is a valuable addition.

On the whole, it may be said that as a work of moderate dimensions conveying the chief facts of inorganic chemistry and an account of those physico-chemical theories which bear especially on inorganic chemistry, Prof. Holleman's book will probably find considerable acceptance in Germany, but it is neither to be expected nor desired that it will set a fashion in its plan of construction. A. S.

Flora of Bournemouth, including the Isle of Purbeck. By E. F. Linton, M.A. With map. New edition. Pp. vii + 290. (Bournemouth: Sold by H. S. Commin, Bright's Stores, and W. Mate and Sons.)

THE local flora embodied in the pages of the book before us appears to be usefully compiled, though perhaps the volume as a whole would have been improved had it been printed on thinner paper, so as to form a more convenient pocket companion. Opening with a short introduction on the physical and geological characters of the district, the author gives a list of some 1137 plants (flowering plants and ferns) as occurring within the area treated of, and adds localities, as is usual in works of this nature. The book should prove useful to those lovers of wild flowers who are visiting the Bournemouth district, to many of whom it may perhaps be a matter of surprise that so large a percentage of the British flora occurs within a twelve-mile radius from the town.

Carnations and Picotees for Garden and Exhibition. By H. W. Weguelin, F.R.H.S. Pp. viii + 125. (London: George Newnes, Ltd., 1900.)

THIS is a book which will be useful to those who are fond of carnations. The cultural hints are clear, and lists are given of many of the best sorts. The text is a little diffuse in places, but in a work of this character that is a pardonable characteristic. The author is enthusiastic on his subject, and his book is worth reading, if only to show what can be done with the flowers as materials for open borders.

LETTERS TO THE EDITOR.

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.]*

Collateral Heredity Measurements in Schools.

As a result of the appeal, made in NATURE last June, for aid in the measurement of pairs of brothers and sisters, I have received friendly help from a number of masters and mistresses up and down the country. I think I have received between 400 and 500 data forms properly filled in. Considerable as this assistance has been, I would still beg for further aid, as I want the collection to reach, if possible, 1000 pairs for each fraternal relationship. I have at the present time several head-spanners free, and shall only be too glad to send one to any teacher who will undertake the necessary observations on six to ten pairs of brothers or sisters. As I said in my former letter, the determination of the intensity of hereditary resemblance is a very important matter, and it can, at any rate in the case of man, only be achieved by co-operative effort on the part of those interested in science. KARL PEARSON.

University College, London, October 9.

The White Rhinoceros on the Upper Nile.

IT may interest your readers to learn that during his recent notable traverse of Africa from South to North, Major A. St. Hill Gibbons shot on the Upper Nile, near Lado, a rhinoceros which he considered to be the white or square-mouthed rhinoceros (*R. simus*), hitherto only known from south of the Zambesi, and now, unhappily, nearly extinct there. His determination is fully borne out by the skull, which I have had the pleasure of examining, and which shows all the many characters that distinguish *R. simus* from the common species, *R. bicornis*.

That a rhinoceros of this group existed in Central Africa has been suspected before. Dr. Gregory in "The Great Rift Valley," mentions having seen in Leikipia, but failed to shoot, three specimens which he believed to be *R. simus*. Some years earlier Count Teleki shot a "White Rhinoceros" in the same district, but his account has more reference to the colour than to the specific determination of the animal, and his specimen may only have been a pale-coloured *R. bicornis*.

Now, however, Major Gibbons has fortunately set the matter at rest, as there can be no question that his animal is not *R. bicornis*, but belongs to the rarer southern form, hitherto supposed to be practically extinct.

The discovery of this animal in the Nile watershed brings it geographically nearer to its European and Siberian ally, the Pleistocene *R. antiquitatis*, both species being in turn, no doubt, offshoots of the Pliocene *R. platyrhinus* of the Siwaliks.

Natural History Museum, OLDFIELD THOMAS.
October 12.

P.S.—This find has an interesting parallel in Mr. W. Penrice's discovery in Angola of a zebra allied to the true Cape Zebra (*Equus zebra*), now also nearly extinct there. But in that case the species proves different by its shorter hair, and much broader white striping, and has been named *Equus penricei*.

Disease of Birch Trees in Epping Forest and Elsewhere.

IN Epping Forest, and in other districts around London, birch trees have been attacked during the late summer by a disease which causes them to die very rapidly. In a portion of the Forest known as Lord's Bushes, thirteen diseased and twenty-four completely dead trees were noted on June 10 within an area of about one and half acres.

A few were attacked in the Forest in the summer of 1899, but it was not till this year that the disease appeared in such a destructive form. On Chiselhurst Common, Hayes Common and Keston Common no signs of the disease were evident in the early summer, but now dead or diseased trees may be found in great numbers. Trees attacked in a similar manner occur at Walton-on-Thames, by the canal between Weybridge and Woking, at Lewisham and at Westerham.

The disease is probably due to a micro fungus, *Melanconis stilbostoma*, Tul., for it appears on the branches of both living and dead trees. The diagnosis of the disease is almost precisely that of *Valsa oxystoma*, described as the destroyer of *Alnus viridis* in some parts of the Tyrol.

It would be interesting to know if any of your readers have observed the disease in the Midlands or in the north of England.

ROBT. PAULSON.

10, Denholme Road, Maida Hill, October 8.

Sunspots and Frost.

IN the study of winter cold, we find, I think, some striking contrasts associated with different parts of the sunspot-curve. These contrasts, whether they are really due to sunspot variations or no, seem worthy of attention as a practical matter, and an occasion for observing whether such relations are maintained in future.

Taking the Greenwich records since 1841, let us see how many frost days there were in each three-year group following the sunspot maxima 1848, 1860, 1870, 1883 and 1893; and how those sums are related to the average (which is 164 in three years). The following table shows this:—

Three-year groups		Frost days		Relation to average
1849–51	...	147	...	−17
1861–63	..	118	...	−46
1871–73	...	131	...	−33
1884–86	...	160	...	− 4
1894–96	...	133	...	−31
		689		−131

Thus, each of those three-year groups was mild, in respect of frost days, and there was a total deficiency of 131 days.

Now, let us do the same with the three-year groups following the minima, 1843, 1856, 1867, 1878, 1889:—

Three-year groups		b Frost days		Relation to average		c $b-a$
1844–46	...	166	...	+ 2	...	+19
1857–59	...	180	...	+16	...	+62
1868–70	...	170	...	+ 6	...	+39
1879–81	..	210	...	+46	...	+50
1890–92	...	201	...	+37	..	+68
		927		+107		+238

In this case, each three-year group is over average, and the total excess is 107 days. The added column ($b-a$) shows that the three-year groups after minima had altogether 238 frost days more than the groups after maxima, giving an average of 47·6 for each pair of groups compared.

If we group together the fourth, fifth, sixth and seventh years after maxima (*i.e.* '52–55, '64–67, '74–77 and '87–90), and count the frost days in those four-year groups, we find that the latter share the character of the three-year groups after minima, each having an excess of frost days over the (four-year) average. We are now in the last year of another of these groups (viz. 1897–1900).

Analysing those mild three-year groups after maxima, we find out of a total of fifteen years only four with more than the average of frost days, and only one group (1884–86) in which two of the three years had an excess.

It occurred to me to examine what kind of summers we had in those mild groups, and the following curious table was arrived at:—

		M.T. Summers.		Relation to average.
		°		
1849–51	...	61·2	...	av.
1861–63	...	60·4	...	− ·8
1871–73	...	61·7	...	+ ·5
1884–86	...	61·2	...	av.
1894–96	...	61·6	...	+ ·4

Thus, the divergence from the average never gets beyond a decimal value. Analysing, one finds only three of those fifteen summers in which the divergence gets beyond a decimal value (viz. −2·4, −1·1 and +1·4). The summers of three-year groups after minima might be shown to have a distinctly opposite character. But I do not lay stress on this.

ALEX. B. MACDOWALL.

Simple Experiments on Phosphorescence.

IN consequence of reading your note in NATURE of September 27, on M. Gustave le Bon's paper on various forms of phosphorescence, the following experiments were tried. A surface, previously dark, of the sulphide of calcium, was exposed to the

radiation of a blackened vessel of boiling water; this gave no decisive result.

On repeating the experiment with a smoothing iron at the temperature ordinarily used, the surface in about a minute glowed brightly. There is this difference from the excitement by bright daylight, or gaslight, that the glow is comparatively transient.

This renders it probable that a cylinder of iron heated by a spirit flame duly concealed would act as M. le Bon's dark lamp does. A. M. M.

MEXICAN SYMBOLISM.[1]

A RESIDENCE for some years among the Huichol Indians of Mexico has enabled Dr. Carl Lumholtz to enrich ethnology with a wonderfully detailed and exhaustive memoir on their symbolism, and our thanks are due, not only to the author, but to the authorities of the American Museum of Natural History for the appearance of this most valuable study, which is lavishly illustrated by more than three hundred figures in the text and four plates, three of which are coloured heliotypes.

It is extremely fortunate for students of American archæology and comparative religion that the symbolism of pagan Mexican Indians should be minutely studied, as this will throw light on the meaning of the inscriptions on ancient Mexican monuments, and will afford illustrations for the comparative studies of cults.

All sacred things are symbols to primitive man, writes Dr. Lumholtz, and the Huichols seem literally to have no end of them. Religion is to them a personal matter, not an institution, and therefore their life is religious, and from the cradle to the grave wrapped up in symbolism. From their symbolism it may be inferred that the main thought of their prayers is food—corn, beans and squashes. Even in the hunting of the deer, the primary consideration is that the success of the chase means good crops of corn. Agriculture depends upon rain, therefore most of the symbolic objects express, first of all, prayers for rain, and, by implication, for food, and then prayers for health, good fortune and long life. In many cases the supplicant himself is represented on symbolic objects in the shape of a human figure or a heart; but in others the god is thus depicted.

The act of sending a prayer to a god is symbolised by attaching a representation of the prayer to an arrow, the painting of the rearshaft of the arrow is symbolic of the special deity to whom the prayer is offered. In other cases, the prayer is directed to the god by placing the symbolic object representing the prayer to the temple of the deity, or by tying it to his chair, or placing it in his votive bowl.

Speaking in a general way, individual or personal prayers are conveyed by arrows or back-shields; these latter are symbols of the rectangular shield that the Huichol warrior wore to protect his back. The main idea of the back-shield is that it protects against the heat of the sun, and prayers expressed by it are largely for health, but also for protection against evil, sickness, accident, &c. Back-shields represent prayers of all kinds, such as prayers for rain, good crops, and even that the supplicant may have children; it should be remembered that the same mat served the warrior as back-shield and bed. Tribal prayers were mostly conveyed by the usually circular front-shields. Personal and tribal prayers may also be conveyed by "eyes." These are crosses of bamboo splints, or straw interwoven with coloured threads in the form of a diamond, The eye is the symbol of the power of seeing and understanding unknown things; the prayer expressed by this symbolic object is that the eye of the god may rest on the supplicant.

The diminutive sandals of an ancient pattern that are attached to a prayer-arrow may be taken as an example of symbolism. Such sandals are now only worn by shamans at the greatest feast of the Huichols—that which is held for the underworld. They therefore become the symbol of a prayer that this feast may come off; also that nothing untoward may happen to the shaman at this feast; but as the feast cannot be celebrated unless a deer has been killed, a pair of such sandals also expresses a prayer for luck in killing deer. In olden time only men wore sandals, which at that time were of the ancient pattern referred to; thus these sandals are also used to express a woman's prayer for a husband.

Practically the same design may be the symbol of various objects, for example, curved lines in general indicate serpents, but when there are dots between curved lines they mean ears of corn in the fields. Bands of curved lines with dots between them are the tracks of wind, rain and water in the fields. Zigzag lines stand not only for rain-serpents but also for lightning, the sea surrounding the world, hills and valleys projected on the horizon, bean plants and squash vines. A cross refers to the four cardinal points, but also signifies money, sparks, &c.

There is a further complication in the strong tendency to see analogies, even the most heterogeneous phenomena are considered as identical. For instance, the following are some of the objects that are believed to be serpents: most of the gods and all the goddesses, the pools of water and springs in which the deities live, the wind sweeping through the grass, the moving sea and ripples of water, flowing rivers, darting lightning, rain, fire, smoke, clouds, their own flowing hair, their girdle ribbons, pouches, wristlets, anklets, maize, bow, arrow, tobacco gourd, trails of men on the land—all are considered as serpents.

On reading this suggestive memoir, one is struck with the fact that the religion of the Huichols contains elements appropriate to two distinct stages of culture. In former ages their ancestors were evidently nomad hunters, who subsisted mainly on the meat of deer, which they killed with bows and arrows. Probably at this period they shot their arrows in the air in magical rites, so as to ensure the killing of deer; possibly also they attached pictographs or symbols to the arrows as messages or prayers to the gods, but this was almost certainly a later phase. On acquiring the art of agriculture, they continued the old practices for ensuring a sufficient food supply. According to the Huichol myths, corn was once deer, and at the feast preparatory to the clearing of the cornfields the Huichols drink the broth of deer-meat, which they call "making corn," and the blood of deer is sprinkled on the grains of corn before they are sown, that they may become equally sustaining, for the deer is the symbol of sustenance and fertility.

Departmental gods generally originate when a people become settled and take to agriculture. The prayer arrows would then be deposited in the houses of the gods. At this time, as at present, the moving principle in the religion of the Huichols was the desire of producing rain, and thus successfully raising corn, which now is their principal food; therefore is it that most of the symbolic objects express first of all prayers for rain and then for other blessings. Since the deer represents sustenance, it may easily be perceived why in their myths water sprang from the forehead of a deer.

There is no space to enter into the cult of that remarkable plant the "Hikuli" (*Anhalonium lewinii*), which is to them the plant of life—the life of the deer and the corn—and adds a further mystical element to this instructive transitional religion. The philosophy of life of these people may be best summed up in a statement by one of themselves. "To pray for luck to the god of fire and to put up snares for the deer—that is, to lead a perfect life." ALFRED C. HADDON.

[1] "Symbolism of the Huichol Indians," by Carl Lumholtz. Memoirs of the American Museum of Natural History. Vol. iii. Anthropology II. 4to. Pp. 228. (1900.)

FURTHER INVESTIGATIONS ON XENIA IN MAIZE.

PROBABLY few botanical discoveries of recent years have aroused more interest than the remarkable observations of Nawaschin upon the fusion of one of the generative nuclei of the pollen tube with the definitive nucleus of the embryo sac. Since further investigations have rendered it not improbable that the process is of general occurrence, its bearing upon some curious phenomena met with in hybrids is of great interest as affording an explanation, not only as to how hybrid embryos, but also how truly hybrid endosperms can be produced by crossing different races of plants. De Vries' beautiful observations upon maize, which were made almost simultaneously with those of Correns, have already formed the subject of an article in this journal, and they have recently been considerably extended by some experiments conducted by Webber[1] in America. As a result of his investigations, Webber concludes, in all cases in which the hybrid corn shows a change of colour, that this is due to the endosperm alone, the translucent pericarp retaining, as might have been theoretically anticipated, the character properly appertaining to the corn of the female parent. But in a large number of instances it was found that, although the embryo on germination showed that hybridisation had occurred, there was no evidence of the transference of the qualities of the male parent to the accompanying endosperm. On the other hand, in some hybrid corns the endosperm exhibited a spotted appearance, which might even (*e.g.* when Gilman Flint was crossed with Stowell's Evergreen) be restricted to only a portion of its substance. The author suggests that the former case might be explained as being the result of failure on the part of the generative nucleus to unite with any nucleus within the embryo sac. The spotted endosperms, on the other hand, might be due to an independent segmentation of the second pollen nucleus, which had failed to unite with the polar nuclei, in which case the portion of endosperm so arising might be expected to retain the characters of the male parent.

There is no inherent improbability in such a suggestion, nor need it necessarily affect any views which may be entertained as to the sexuality of the fusion which we are (perhaps rather hastily) beginning to regard as general; the investigations of Boveri and of Hertwig respectively have shown that the nuclei of both male and female reproductive cells of sea-urchins can be made to segment by appropriate means, and even produce larvæ, and this without any preceding fusion of the sexual cells themselves.

It is clear, however, that much more investigation is required before the points raised by Dr. Webber can be cleared up, but it is to be hoped that so promising a field of research will not be left to lie fallow, although the work itself will necessarily prove arduous.

[1] "Xenia, or the Immediate Effect of Pollen in Maize," by Herbert J. Webber, U.S. Department of Agriculture, *Bulletin* 22, Washington, 1900.

PORTABLE GAS PRODUCERS.

AIR-GAS, as it is popularly called, consists of an admixture of ordinary atmospheric air with the vapour of one of the volatile hydrocarbons, such as pentane, gasolene or petroleum spirit. Travellers and others having called attention to the production of a natural gas in the petroleum-bearing districts, as at Baku and elsewhere, it was not long before attempts were made to imitate the workings of nature by producing from the petroleum of commerce a combustible gas. The carburetting of ordinary air by forcing a current over liquid petroleum first seems to have been proposed by Lowe in 1831, as in that year he took out a patent for his apparatus.

Air-gas producers may be roughly classified as follows:—

(1) Apparatus in which air is *forced under pressure* either through or over liquid petroleum, in which class mention may be made of the apparatus of Jackson, Müller, Weston and Maxim.

(2) Apparatus in which, on account of the danger of using large quantities of liquid petroleum, an absorbent is used to take up the hydrocarbon, either in part or entirely, the air being, as in the first case, *forced under pressure* over or through the absorbent.

Considerable commercial importance attaches to certain of the apparatus mentioned under the two classes given above, both the "Alpha" apparatus of Müller and the "Sun" apparatus of Hearson having had a considerable success, both here and in America, for the lighting of country houses and the like. It will be easily seen, however, that the necessity of having some *motive power* to actuate the current of air introduces complex mechanism which militates against the general adoption of such apparatus. This disadvantage has, however, been met by the apparatus comprising the third and last class of

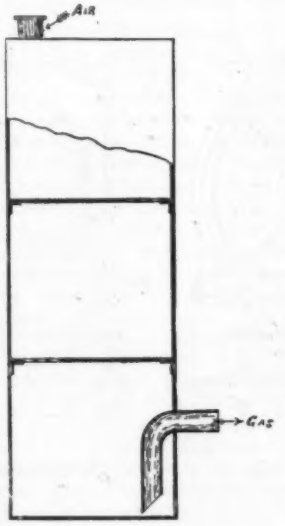


FIG. 1.

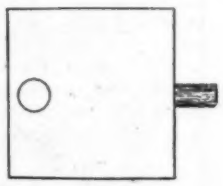


FIG. 2.

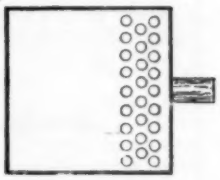


FIG. 3.

aero-gas generators, which possess a peculiar interest on account of their simplicity and efficiency.

In 1895 Mr. Naum Notkin, of Moscow, was struck with the idea that use might be made of the physical property that carburetted air is considerably heavier than ordinary atmospheric air for the construction of a gas-producing apparatus of extreme simplicity. His method and apparatus, which are patented in Great Britain (No. 20667/94), may be described as follows:—

The apparatus consists essentially of a vessel of tin or other material, with an orifice at the top and another at the bottom. This simple vessel is filled with a porous material which is impregnated from time to time with one of the lighter hydrocarbons, and this constitutes the whole apparatus. The action of the apparatus is that ordinary atmospheric air enters at the upper orifice, and taking up a certain proportion of hydrocarbon vapour becomes heavier and *gravitates* through the mass of absorbents, taking up more and more of the hydrocarbon vapour, until it finally issues from the lower orifice in the form of a gas capable of lighting, heating, and all other uses to which ordinary gas is put. Not only does the

gaseous mixture become heavier, but it becomes cooler by the rapid volatilisation of the petroleum, and this cooling action is greater the more rapid the passage of air through the receptacle. As the absorbents may be regarded as solids, there is no danger either from the presence of loose petroleum or of explosion.

These carburetters (or, as they are termed, aero-gas fountains), in the form best adapted for lighting and heating purposes, consist of a reservoir of ordinary tin, with an air admission regulator at the top and a bent draw-off pipe at the bottom, the pipe being so designed as to syphon out the gas and prevent the possible overflow of any loose petroleum that might be left on the bottom from an overcharge. Fig. 1 is a vertical section of such a carburetter. The carburetter is divided horizontally by two perforated shelves, the object of which is to produce a longer travel of the gas, and to distribute it through the perforations. Fig. 2 is a plan of the top of this fountain, while Fig. 3 is a drawing of one of the perforated shelves. The absorbent is a species of wood pulp which is entirely unaffected by the petroleum, and acts merely as a means of holding it in suspension.

With the carburetter as applied to table and other lamps, the burners used are argands, with steatite centre and very wide gas ways. The light is of high illuminating power and of remarkable purity. For street lighting the carburetter forms part of the lamp, which has a hinged top, so that when the carburetter is exhausted it can be lifted out and a fresh one put in its place. For ships' lights, as well as in railway and other signal lights, the system offers peculiar advantages. With respect to heating, all classes of stoves can be adapted for this system.

There is one other most important branch of lighting for which the carburetter is designed, namely, light-houses, beacons and buoys. The advantages of gas as an illuminant were early apparent to lighthouse authorities, and in the Government inquiry into the relative advantages of paraffin, gas and electricity as sources of light for lighthouse illumination, the superiority of gas was clearly pointed out, but owing to the necessity of elaborate plant needing to be installed in the vicinity of each lighthouse to be lit by gas, it was pointed out that, despite its intrinsic advantages, it could not be recommended on account of the expense and difficulty entailed in the production. Since those days, however, the Pintsch system of vaporising oil for gas, despite its costliness both as regards the gas produced and the plant required, has been largely made use of by the lighthouse services both at home and abroad. The simple automatic carburetters that have just been described will, it is clear, place within reach of the lighthouse authorities the possibility of making use of gas-light in place of the paraffin lamps now in common use. Figs. 4 and 5 show section and elevation of a third order dioptric apparatus in which the carburetters are placed above. In place of the oil tanks required for the storing of the paraffin, the tin carburetters can be served out to the various stations ready charged, and these can be returned when exhausted and fresh ones supplied. As the absorbent takes up about three-quarters of its own volume of liquid, it is seen that the room required for storing the fountains or carburetters is little more than that needed for the present paraffin supply. As the flame given from this aero-gas is steady and constant, the trouble of maintaining the old paraffin burners of many wicks, so as to give a constant light, is obviated. By doing away with the constant level and pressure arrangements now in vogue, a considerable economy will be effected in light-house apparatus, while at the same time the risk will be lessened of a failure of some part of the mechanism.

In their application to engines for motor-cars, launches, &c., these fountains have a very wide field of usefulness, in which they offer advantages that cannot be secured without them.

J. A. PURVES.

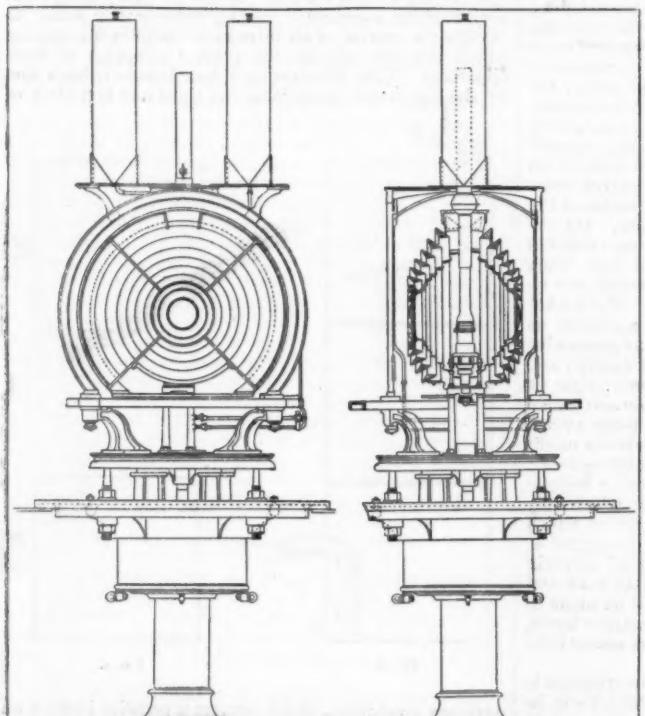


FIG. 4. FIG 5.

NOTES.

WE regret to see the announcement of the death of Sir Henry Wentworth Dyke Acland, K.C.B., F.R.S., late Regius professor of medicine in the University of Oxford. The funeral will take place to-morrow (Friday) at Holywell Cemetery, Oxford.

PROF. T. G. BONNEY, F.R.S., has resigned the chair of geology which he has worthily occupied at University College, London, for a period of twenty-three years. The chair will become vacant at Christmas.

THE works of the late Prof. E. Beltrami (consisting of three or four large volumes) are to be issued on subscription by the Faculty of Science of the University of Rome.

A REUTER telegram from Kingston, Jamaica, states that the scientific expedition sent by Harvard University, to observe the minor planet Eros during the approaching opposition, has arrived there under the leadership of Prof. Pickering.

SIR LOWTHIAN BELL, F.R.S., has been elected president of the Institution of Junior Engineers in succession to the Hon. C. A. Parsons, F.R.S.

THE anniversary meeting of the Mineralogical Society will be held on Tuesday, November 13, at 8 p.m., when a new set of bye-laws will be recommended for adoption by the committee and council of the Society.

A REUTER telegram reports that Mr. William Zeigler, a wealthy citizen of New York, will supply the funds for an expedition to start early in 1901 under Mr. Evelyn Baldwin, in the hope of reaching the North Pole. The expedition will sail in two steamers.

AT the recent meeting in Paris the International Geodetic Association discussed the difference of longitude between Paris and Greenwich, with special reference to the discordant results obtained by the French and English astronomers in 1888 and 1892. General Bassot attributed the want of agreement to an imperfect knowledge of the constant of electrical transmission of the signals. The difference of longitude will be measured again next year.

A NEW departure, which should be of much assistance to lecturers, has been made by the Sanitary Institute. Frequent applications having been made to the Institute for the loan of lantern slides and diagrams for lecture purposes, the council have collected a large number of such slides relating to sanitary arrangements and appliances, diseases, &c., which can be borrowed by members and associates for lecture purposes at a small charge. A list of 611 slides at present available can be obtained from the secretary of the institute.

THE *Board of Trade Journal* says that information has just been received, by the Imperial Academy of Science, of the discovery of diamondiferous deposits on the Kamenka, a tributary of the Sanarka. This, it is reported, is the first time that diamonds have been discovered in this region, although the existence of such deposits in the neighbourhood of the Sanarka had already been indicated. It is stated that in structure and colour the diamonds found resemble those of Brazil.

THE annual general meeting of the London Mathematical Society will be held on November 8, at 5 30 p.m. The following nominations for the new council have been made:—Dr. Hobson, F.R.S., president. Lord Kelvin, Prof. Burnside, F.R.S., and Major MacMahon, F.R.S., vice-presidents. Other members:—J. E. Campbell, Lieut.-Colonel Cunningham, R.E., Prof. Elliott, F.R.S., Dr. Glaisher, F.R.S., Prof. M. J. M. Hill, F.R.S, A. B. Kempe, F.R.S., H. M. Macdonald, A. E. Western and E. T. Whittaker. The treasurer (Dr. Larmor, F.R.S.) and hon. secretaries (R. Tucker and Prof. Love, F.R.S.) are renominated. Lord Kelvin will probably not be able to give a valedictory address.

THE foundation stone of the Imperial "Limes" Museum, which is to be erected in the restored Roman fort of the Saalburg in the vicinity of Homburg, was laid by the German Emperor on Thursday last. The museum is to contain the Roman relics which have been discovered in the excavations in the neighbourhood of the "Limes Transrhenanus," the great Roman wall which extended from the Danube to the Rhine. The excavations were begun in 1873, and have brought to light many objects of great interest, which have hitherto been placed in the Saalburg Museum at Homburg. They will be removed to the new museum as soon as it is completed. The Emperor sent a congratulatory telegram in Latin to Prof. Mommsen, who was unable to be present at the ceremony.

THE Philosophical Faculty of the University of Göttingen has (says *Science*) proposed the following subject for prizes on the Benecke Foundation: A critical investigation, based upon experimental research, of those complex chemical compounds which cannot be explained upon the ordinarily received theory of valence, or can be so explained only by a forced interpretation of the theory. This investigation should specially consider how far the phenomena of molecular addition play a part in the formation of these compounds and as to whether it is possible to formulate a comprehensive theory of these complex compounds. The first prize is 3400 marks and the second prize 680 marks. Papers in competition must be written in a modern language, and be accompanied by a sealed envelope containing the name, a motto on the outside of the envelope corresponding to the same motto on the paper. They should be sent to the Faculty of the University of Göttingen not later than August 30, 1902.

IN the year 1895 the Academy of Sciences of Berlin announced the following problem for the Steiner prize:—"To completely solve any important hitherto unsolved problem relating to the theory of curved surfaces, taking into account, so far as possible, the methods and principles evolved by Steiner. It is required that sufficient analytical explanations shall accompany the geometrical investigations to verify the correctness and completeness of the solution. Without wishing to limit the choice of subject, the Academy takes the opportunity to call attention to the special problems to which Steiner has referred in his general remark at the end of his second paper on maximum and minimum in figures in a plane, on a sphere, and in space." The foregoing problem having remained unsolved up to the present, the Academy again announces it for the year 1905. For its solution a prize of 4000 marks is offered, with an additional sum of 2000 marks. Papers sent in competition may be written in German, French, English, Italian, or Latin, and must be submitted before December 31, 1904, to the Bureau of the Academy, Universitäts-Strasse 8, Berlin N.W. The result will be announced at the Leibnitz meeting of 1905. Each manuscript submitted must bear a mark or *nom de plume*, and be accompanied by a sealed envelope containing the name and address of the author, and bearing outside the corresponding mark or assumed name.

THE Society for the Protection of Birds is offering two prizes, of 10*l.* and 5*l.* respectively, for the best papers on the protection of British birds. The mode of dealing with the subject is left entirely to competitors, but among the points suggested for treatment are the utilisation and enforcement of the present Acts and County Council Orders; the modification or improvement of the law; educational methods; and the best means of influencing landowners and gamekeepers, agriculturists and gardeners, collectors, bird-catchers and bird-nesters. Essays are to be sent in by November 30. Particulars may be obtained from the hon. sec., at the Society's offices, 3, Hanover Square, London, W.

DURING the last few weeks even the scientific recluse, occupied as he mostly is in the *recherche de l'absolu*, has had forced upon him, by serious and comic papers alike, the question of electioneering cries. Perhaps, however, it will be news to him that the subject of vivisection, so-called, has been pushed into the forefront of electioneering polemics. Warning was indeed given months ago that this might be the case as is evidenced

by the contents of certain letters published in Mr. Paget's book. These letters, addressed to several of Her Majesty's Ministers, threatened, in no unmistakable terms, should these officials not become anti-vivisectionists, to use against them at the next election organised opposition, which would probably prevent them being returned to Parliament by their respective constituencies. To what extent this has actually been done we have no means of knowing, but our attention has been drawn to a letter in the *North Down Herald and County Down Independent* in comparison with which the diatribes of Mr. Coleridge sink into insignificance. The interest, however, of Miss Margaret Alder's letter does not centre in its actual abuse, but in the fact that she places vivisection first among various causes which have rendered Englishmen "fit to kill, murder and rob the peaceable and pious people of South Africa." This conclusion possibly explains why during the past few months many physiologists—even those whose problems lie, for the most part, outside the field of actual animal experiments—have received daily papers and magazines in which attention has been directed by means of blue pencil to letters and articles in which the ingenuity of the pamphleteer has been used to distort the aims and results of the physiologist. Henceforth the anti-vivisectionist societies, one and all, had better be known under their true colours. They are not honest organisations sustained by conscientious thinkers, or even artistic sentimentalists, but pigmy political cliques for turning the trend of political opinion one way or another.

THE lecture session at the Imperial Institute will be opened on October 29 with a lecture entitled "The Federal Family," by Sir John A. Cockburn, K.C.M.G. This lecture is the first of a special series of eight illustrated public lectures, relating to the Australasian Colonies, to be given on Monday evenings before Christmas. The remaining lectures will be as follows:—"Golden Victoria, its scenery, geological features, and mines," by Mr. James Stirling; "Western Australia in 1900," by Mr. George Berry; "The coal resources of Victoria," by Mr. James Stirling; "The work of the Queensland weather bureau, in its relation to the natural resources and commerce of Australasia," by Mr. Clement L. Wragge; "The Australian Alps, scenery, native vegetation, and mineral wealth," by Mr. James Stirling; "New Zealand," by Mr. J. Carthcart Wason; "Sunny Tasmania for English Invalids," by the Hon. Sir Philip Oakley Fysh, K.C.M.G.

AN important addition to the British Museum (Natural History) has just been made in the form of mounted specimens of two beautiful antelopes from the swamps of the White Nile, belonging to species hitherto very imperfectly represented in the collection. They are, in fact, the first complete specimens of their kind which have ever been exhibited in England. The species are *Cobus maria* and *C. leucotis*, both remarkable for their sable hue (at least in the males), relieved by white on the ears, and also the elegant and peculiar curvature of their heavily ringed horns. Of the former species the Museum possessed the heads of a male and female presented by the late Consul J. Petherick in 1859, which are in such a bad condition that they have not been exhibited to the public for several years, while the latter was best represented by a stuffed head (also the gift of the same gentleman), which is, however, so faded that its true colours are completely lost. For the new specimens (which have been set up by Rowland Ward) the Museum is indebted to Captain Dunn, now stationed, we believe, at Omdurman, by whom they were presented. Acknowledgments are, however, also due to Captain Stanley Flower, by whom the skins were brought to this country. The specimen of *C. leucotis* is exhibited in the case devoted to new acquisitions, but, on account of its larger size, the example of *C. maria* is placed in the case in the West Corridor which will eventually form the home of both.

THE meteorological subcommittee of the Croydon Microscopical and Natural History Club has just published its report for the year 1899. It contains valuable information relating to the daily and monthly rainfall statistics for eighty stations in Kent and Surrey, together with notes relating to the temperature and weather for each month, by Dr. F. C. Bayard, the hon. sec. of the subcommittee. The observations show that the deficiency of rainfall throughout the district was about two inches. The deficit does not appear very large, but some tables showing the total departures from the average during the last ten years reveals a serious state of things. For Greenwich, for instance, the departures from the average of eighty years show a deficit of twenty-eight inches, which is practically three inches above a year's average rainfall. And again, for Surbiton, on the western side of the club's district, the departures during the same period show a deficiency of 19·5 inches, compared with an average of forty years, or a deficiency of practically only five inches below the average rainfall for a year.

THE report on the administration of the Meteorological Department of the Government of India in 1899–1900 has appeared in the same form as in previous years; the first part gives a general account of the results of the more important sections of the work of the department, and the second part gives the usual details of administration, chiefly in the form of tables. Seismological observatories have been established at three stations. The international and special cloud observations referred to in previous reports will be shortly published, with a brief discussion. The arrangements for registration of snowfall in the mountain districts and the measurement of rainfall continue to form an important part of the work of the Indian Meteorological office; monthly returns from 2300 rainfall stations were published during the year. The storm-warning work was carried out satisfactorily; ample and timely warning appears to have been given of all the more important storms. The special warnings of floods also appear to have given general satisfaction.

THE current issue of the *National Geographic Magazine* contains an article, illustrated by diagrams, on "The West Indian Hurricane of September 1–12, 1900," by Prof. E. B. Garriott, of the U.S. Weather Bureau, and another by Mr. W. J. McGee, entitled "The Lessons of Galveston." The Lessons in question are four in number, three of which are physical and one is human. The former are as follows:—1. The danger of building on sand, Galveston being founded on a sand-bank; 2. "The bank on which Galveston was built is something more than a simple heap of silicious grains and dust; it is a record of past wave work;" and "it is the duty of the nature student to interpret natural records and guard against the building on the storm records." Lesson 3 is that of coast subsidence, and, in the opinion of the author, "it is the business of the geologist to detect and weigh the evidences of subsidence or elevation of coasts, and to estimate the rates of movement for the guidance of local residents and investors, and it behoves such citizens to avail themselves of the scientific researches."

TO the *Journal* of the Franklin Institute, Mr. Lewis M. Haupt, an American engineer of reputation in matters relating to river training and harbour work, contributes a paper dealing with the present condition of the navigation in the lower reach of the Mississippi, in which he advocates that the principle of reaction jetties should be applied for dealing with the contemplated improvement of the South-west Pass. The Mississippi affords an outlet into the Gulf of Mexico for 15,000 miles of navigable waterways. In the delta the main stream divides into three principal branches, and although the water is of great

depth in the channel before it enters the delta, in their natural condition these channels are so shoal as only to afford sufficient depth of water for the navigation of the smaller class of steamers. About a quarter of a century ago Captain Eads entered into a contract with the United States Government to deepen one of these passes so as to give 27 feet at low water, and to maintain this depth for a fixed period. Contrary to his strong remonstrances the South Pass, the smallest of the three outlets, was selected. Through this pass, by means of two parallel training walls, the water was confined to a width of 700 feet, and by the scour thus created, aided to a large extent by dredging, a channel having 26 feet at low water was made, and has been maintained up to the present time. This contract has now expired, and the dimensions of vessels in the meantime having outgrown the channel, the Government have had to consider the question of providing a deeper waterway. The Board of Engineers to whom the matter has been referred have advised that the South-west Pass should now be improved and deepened so as to give a depth of 35 feet at low water.

THE Board of Agriculture has published its annual report for the year 1899–1900 on the distribution of grants for agricultural education and research, with statements respecting the several colleges and institutions allied and the experiments conducted. The larger portion of the funds distributed in grants by the Board consists of subventions of a general character awarded to eight collegiate centres of agricultural education in England and Wales. Subsidiary grants have also been made to three dairy institutes, and in aid of the cost of certain specific experiments undertaken under arrangement with the Board. Examinations have also been conducted under the joint auspices of the Royal Agricultural Society and the Highland and Agricultural Society of Scotland for the recently established national diploma.

MR. HAROLD WAGER reprints from the *Journal* of the Linnean Society an interesting paper on the eye-spot in *Euglena*. He finds it to consist of a mass of pigment-granules apparently imbedded in a protoplasmic matrix. The light absorbed by the eye-spot seems to act upon a swelling near the base of the flagellum, and thus to modify its movements. *Euglena* appears, therefore, to possess a very simple form of light-organ, consisting of a sensitive region—the swelling on the flagellum—and a light-absorbing pigment-spot.

IN a note contributed to the *Rendiconto* of the Naples Academy, vi. 5-7, Dr. Giuseppe de Lorenzo discusses the probable causes of the increased activity of Vesuvius at the beginning of May last. This activity assumed the form of "Strombolian" explosions audible as far away as Posilipo, by which masses of incandescent lava were hurled into the air to an altitude of about 500 metres. These explosions Dr. de Lorenzo attributes to the exceptional rainfall, which, filtering through the volcanic cone, has penetrated to the column of lava. This hypothesis appears in conformity with the observations of Spallanzani, von Rath, Dana and others, and with the experimental researches of Daubrée.

TWO papers on the figure of the earth have recently appeared, one, by M. Marcel Brillouin, in the *Revue générale des Sciences*, xiv., and the other, by Ingeguere Ottavio Zanotti Bianco, in the *Atti* of the Royal Academy of Turin, xxxi. M. Brillouin discusses the different geoïdic surfaces adopted in the problem of reduction to sea level, and points out the relative advantages of the geoïds of Pratt and Helmert. Bianco's paper contains extracts from the writings of Pratt and Helmert, showing the relative part played by these investigators and by Bruns in developing the general theory of geoïdic surfaces.

THE Selborne Society's magazine, *Nature Notes*, contains in its September issue an interesting account of a mirage, seen last June over the Needles (Isle of Wight) from the opposite shore, by Captain Giles A. Daubeny. It is not uncommon when looking at a distant headland to see the appearance of a pointed nose jutting out over the water—an effect caused by the formation of an inverted image near the water-line; but in the present instance four different horizons appear to have been observed when viewing the rocks through a telescope.

THE admirable series of memoirs published by the U.S. Department of Agriculture on the harmfulness or otherwise to the agriculturist and horticulturist of the commoner birds of North America has recently been augmented by one from the pen of Mr. F. E. L. Beal, dealing with the food of the bobolink, blackbirds and grackles. This memoir forms *Bulletin* No. 13 of the Department. The bobolink is an exception to most birds in that, both at seed-time and harvest, it inflicts immense damage on the rice-crops of the Southern States. At present, therefore, the harm it does far outweighs such benefits as it may confer; but as the bird could exist perfectly well without touching a grain of rice, hopes are entertained that means may be found of checking its depredations on that crop. On the other hand, most or all of the so-called blackbirds (which are not to be confounded with the species of the same name in Europe) feed largely upon noxious insects and weed-seeds, and are therefore highly beneficial to the cultivator. Much the same may be said of the grackles. As usual, the *Bulletin* is illustrated with good figures of the species described, and the whole publication does the greatest credit to the Government by whom it is issued.

Bulletin No 67 of the West Virginia University Experiment Station is devoted to a communication by Dr. A. D. Hopkins on the Hessian fly in West Virginia, and how to prevent losses by its ravages. As the result of his investigations, the author finds that the date of the appearance of the swarms of this insect depends upon the latitude and altitude of the place, and he gives a formula by means of which the former may be approximately determined for any particular locality. From this the dates may be calculated at which it is reasonably safe to sow wheat in order to escape loss from the ravages of the pest. The approximate limits of the best wheat-sowing period, and also the approximate normals for the disappearance of the fly in different districts, are graphically illustrated by means of a map.

THE September issue of the *American Naturalist* commences with an interesting paper, by Miss (or ? Mrs.) Sampson, on unusual modes of development among frogs and toads. Commencing with a *résumé* of the normal mode of breeding as exemplified in the common frog, the author goes on to show how different members of the group depart from this mode of procedure. Two species, for example, the one from West Africa and the other from Brazil, deposit their spawn in nests formed of leaves stuck together, the tadpoles moving in a mass of froth, recalling that of the cuckoo-spit insect. In both these instances the spawn is deposited in the neighbourhood of water, into which the tadpoles ultimately fall; but in a tree-frog from Rio, in which the eggs are likewise hatched in a frothy mass among leaves, the larvæ actually die if they are put into water. In another Brazilian tree-frog the tadpoles frequent cracks in rocks, and adhere to the surfaces of the latter by means of an abdominal sucker. Full reference is made to the mode of development in the Surinam toad, and also to that of the marsupial frogs, in which the young are hatched in a dorsal pouch. But perhaps the most extraordinary "nursery" arrangements in the entire group are those of the Chilian Rhinoderma, in which the tadpoles undergo their development in an enormous pouch on the throat of the male. In the same journal Mr. F. Russell has a paper on cranial abnormalities in the American races, among some of whom the persistence of the frontal suture may occur as frequently as 2·9 per cent.

THE October issue of the *Entomologist* contains a summary of the capture of rare British insects during the past summer and autumn. In addition to the swarms of the pale clouded yellow butterfly (*Colias hyale*), to which allusion has been already made, no less than ten examples of the Camberwell beauty (*Vanessa antiopa*) are recorded as having been taken in the south-east and east of England. Caterpillars of the death's-head moth (*Acherontia atropos*) have been extraordinarily abundant in potato crops during the season, and many other rarities are recorded.

THE *Bulletin* of the American Mathematical Society for October contains a useful list of courses in mathematics announced by seventeen German universities for the 1900–1901 session.

THE Department of Mines, Victoria, has issued No. 7 of the Reports of the Victorian Coal-fields, by Mr. James Stirling, the Government geologist. It consists of descriptions, with illustrations, of the fossil flora of the Jurassic beds of South Gippsland.

A SIMPLE description of the movements and obvious characteristics of the members of the solar system, and other celestial bodies, is given in Mr. W. T. Lynn's "Astronomy for the Young" (pp. 51), the second edition of which has just been published by Mr. G. Stoneman, London, E.C.

THE lecture syllabus of the Hull Scientific and Field Naturalists' Club for the winter session ranging from October to March has just reached us, and gives promise of a full and interesting winter's work. Judging by the contents of the *Transactions* of the Club for 1900, a copy of which has also been sent to us, the institution is in a healthy and vigorous condition.

COUNTY floras have at present been pretty much confined to flowering plants and fern allies. We welcome the precedent set by the Yorkshire Naturalists' Union in issuing an Alga-Flora of Yorkshire, being a complete account of the known freshwater algæ of the county, by Mr. W. West and Mr. G. S. West. The present publication, which is only a first instalment, includes 208 species.

THE October number of the *Contemporary Reveiw* contains two articles of scientific interest, one, by Prof. Marcus Hartog, on "Interpolation in Memory," and one by Mr. A. Shadwell, entitled "The true aim of Preventive Medicine." The current issue of the *Humanitarian* has in it a very readable contribution on "Heredity as a Factor in the Interpretation of Disease," from the pen of Prof. D. J. Hamilton of Aberdeen.

A PROOF of old Semitic influence in South Africa is afforded, according to K. Meinhof (*Globus*, Band lxxviii. p. 203), by the occurrence of the word "daramu" or "ndalama" in various Bantu dialects for "gold." An ancient Arabic word for gold was "dirhem," pl. "darāhim." According to the phonetic system of the Bantu languages this would necessarily be transformed into "ndalama."

MR. C. FOX-STRANGWAYS contributes some interesting notes on Spitsbergen and Iceland in the *Transactions* of the Leicester Philosophical Society for April, 1900. Having spent only a short time on these islands, the author does not claim to record much that is new regarding them, and his article is written chiefly in explanation of a series of photographs which are reproduced to accompany the notes.

THE additions to the Zoological Society's Gardens during the past week include a Brown Capuchin (*Cebus fatuellus*) from Guiana, presented by Mrs. W. L. Gower; two Yellow-whiskered Lemurs (*Lemur xanthomystax*) from Madagascar, presented by Mr. J. B. Joel; a Common Genet (*Genetta vulgaris*), European, presented by Baron de Soutellinlio; an Alligator (*Alligator mississippiensis*) from North America, presented by Mrs. Bazalgette; a Porose Crocodile (*Crocodilus porosus*) from the East Indies, presented by Miss Gwendoline Waite; a Broad-nosed Lemur (*Hapalemur simus*) from Madagascar, four Indian Fruit Bats (*Pteropus medius*), six Starred Tortoises (*Testudo elegans*) from India, a Dusky Sloth (*Bradypus infuscatus*) from Colombia, an Illiger's Macaw (*Ara maracana*) from Brazil, two Salvin's Amazons (*Chrysotis salvini*), an Annulated Terrapin (*Nicoria annulata*), a Brazilian Tortoise (*Testudo tabulata*), an Electric Eel (*Gymnotis electricus*) from South America, four Wrinkled Terrapins (*Cyclemmys scripta rugosus*) from the West Indies, a Common Water-Buck (*Cobus ellipsiprymnus*) from South Africa, deposited; a Violaceous Night Heron (*Nycticorax violaceus*) from South America, purchased.

OUR ASTRONOMICAL COLUMN.

EPHEMERIS FOR OBSERVATIONS OF EROS:—

1900.		R.A. h. m. s.		Decl. ° ′ ″
Oct. 18	...	2 36 36·00	...	+50 47 13·4
19	...	35 30·95	...	51 4 38·6
20	...	34 21·37	...	51 21 32·0
21	...	33 7·26	...	51 37 51·5
22	...	31 48·74	...	51 53 35·1
23	...	30 25·82	...	52 8 41·0
24	...	28 58·65	...	52 23 7·4
25	...	2 27 27·35	...	+52 36 52·0

NEW PLANETARY NEBULA.—Mr. R. G. Aitken writes to the *Astronomische Nachrichten* (Bd. 153, No 3667) announcing that the object catalogued as star BD + 83°·357 is a small planetary nebula. With the 36 inch Lick telescope the object appears to have a stellar nucleus of about 10 5–11 magnitude centrally placed in a circular nebulous envelope about 5″–6″ of arc in diameter. The complete object is about 9·5 magnitude, and its position is:—

	h. m. s.	
RA.	12 29 10	(1855·0).
Decl.	+ 83° 21′·8	

PARIS OBSERVATORY, ANNUAL REPORT.—In his report of the work accomplished at the Paris Observatory during the year 1899, M. Loewy, the director, states that a considerable part of the time was spent in preparing for the Exposition. Special photographs on a large scale were taken of the moon about the time of first and last quarter, giving an image about 1·38m. in diameter; considerable difficulty was encountered in the preparation of the plates for these, and special mention is made of the services rendered by MM. Lumière in this matter. Among the new instruments adopted are (*a*) the mercury bath designed by M. Hamy for registering earth tremors, (*b*) a new micrometer by Gautier for measuring the chart plates, (*c*) a new form of chronograph designed by M. l'Abbé Verschaffel, director of the Abbadia Observatory. This latter has been introduced for use in the proposed new determination of the difference in longitude between Paris and Greenwich.

For the chart photographs ninety-six sheets have been issued, and the first part of the catalogue, giving the exact positions of stars down to the eleventh magnitude, will be issued during the present year. An investigation is in progress for determining more accurately the photographic magnitudes of stars. Valuable help has been given by M. l'Abbé Verschaffel, of Abbadia, who has determined the coordinates of 3700 fundamental stars of reference for the chart photographs. A fourth volume of the "Atlas de la Lune," containing seven plates, has been published, accompanied by a descriptive memoir.

M. Bigourdan has continued his study of the nebulæ, having now measured the positions and made detailed study of 6000 of them; to complete his programme of work 400 more still remain to be examined.

The small equatorial Coudé, which was the first instrument of this type, has been entirely remodelled. A new objective has been made by MM. Henry, of longer focus than the old one (5·25 metres instead of 4·22), the silvered mirrors protected more from the action of atmospheric gases, and the whole instrument encased in a thick layer of felt. These modifications have removed all the defects existing in the old telescope.

RANGE-FINDERS.[1]

NAVAL and military authorities are agreed that for accurate shooting almost everything depends upon the range being known with sufficient exactitude. It is not surprising, therefore, that an immense amount of attention should have been devoted to methods of rapidly determining the ranges of distant objects, whether stationary or in motion. These methods may be classified as follows:—

(1) *Mechanical.*—In this method a trial shot is fired from a gun, and so far as is practicable observation is made as to whether the shot strikes the ground (or the sea) on the near or the far side of the target. The results of the observation are used to correct the next trial shot, and so on. The method is clumsy and (at all events on board ship) costly; it is inapplicable in a naval engagement where the ranges frequently alter with great rapidity, and is, of course, totally inapplicable for purposes of navigation. On the other hand, it involves the use of no instrument beyond those ordinarily used in warfare.

(2) *Flash and Sound Method.*—Here the time-interval between seeing the flash and hearing the report from one of the enemy's guns is measured by a suitable chronograph or, by starting to count at the rate of eleven in three seconds immediately on seeing the flash; the number arrived at on hearing the report will roughly give the number of hundreds of yards in the range. This method is, of course, inapplicable amid the din of a general engagement, and besides it permits the enemy to have the first shot.

(3) *Optical Range-finders.*—In the determination of a distance by an optical range-finder, *length of base* and *time* available are very important factors. Given plenty of base-length and plenty of time, a theodolite, such as is used in surveying, satisfies all the conditions except that of portability. However, *time* is usually so important a factor for military operations that the theodolite is completely excluded even for field service. If the time is restricted, but the extent of base unrestricted, recourse may be had to long-base, two-observer instruments, such as those now in use by infantry and field artillery. When both base and time are restricted, as they are on board ship—and moreover the observer's station is itself in motion—the problem becomes at once much more difficult and much more interesting. We need not then be surprised that while military range-finders are usually simple and cheap, naval range-finders are comparatively costly and complicated.

The operation of all optical range-finders depends upon the measurement, by some device or other, of the angle subtended by a known base-length at the distance to be determined, the base being almost invariably "broadside-on" to the point. Where the known base is at the target and the point is at the observer's station, the operation of determining the distance consists simply in measuring the angle subtended by the base at the point. Instruments of this class measure, say, the angle subtended by the height of a man (assumed to be of mean stature) at the observer's station, and require for their successful employment the co-operation, willing or otherwise, of the enemy, and are therefore seldom applicable under the conditions of modern warfare. Men who have returned from active service in South Africa have stated that sometimes they never saw a Boer in an engagement. Where the known base is at the observer's station, which is an essential characteristic of all range-finders of general application (the instruments previously described being in reality mere angle-measurers), the operation of determining the range consists almost invariably in swinging the base round until it is "broadside-on" to the target, and then measuring the angle subtended by the base at the target. The measurement of the angle at the target is very commonly effected by making one of the base-angles a right angle, and observing how much the other is "off" the right angle (mekometer, &c.), or else by observing how much the sum of the base-angles is less than two right angles (naval range-finder, &c.).

Since a mere enumeration of the names of inventors of range-finders would occupy the whole of the available time for a lecture, it will be necessary to restrict the selection of examples to those instruments which are, or promise to be, in actual operation for warlike purposes. Attention then will be confined to the following instruments:—

(1) The Watkin mekometer, used by our troops in South Africa.

(2) The Watkin depression range-finder, used at certain stations for coast defence.

(3) The Zeiss tele-stereoscope.

(4) The Barr and Stroud range-finder, used in the British and other navies, in coast fortifications, and to some extent in the field.

Restrictions of time unfortunately render it impossible to describe the Watkin artillery range-finder, as well as the Fiske instrument which is used to some extent by the U.S. Navy.

(1) *Mekometer.*—This instrument consists of two parts connected by a cord 25 or 50 yards long, which is kept tightly stretched by two observers, each of whom supports one of the parts. These two observers are designated respectively the right-angle man and the range-taker. The former carries a small optical square or instrument in which two mirrors are fixed at 45° so as to set out a right-angle.

The part carried by the range-taker consists practically of a box-sextant in which one of the mirrors is adjustable by means of a graduated micrometer-screw, on which the ranges are marked for the base specified, the infinity mark corresponding to the case when the mirrors are exactly at 45°. Each of the parts of the instrument carries a prominent mark in a suitable position, and the operation of taking a range on a fixed object is as follows:—The two observers supporting the instruments connected by the taut cord set themselves in such positions that the cord is nearly "broadside-on" to the target; the range-taker now stands still, while the right-angle man—by moving forwards or backwards, with the cord always taut—adjusts his position accurately, so that the image of the mark on the range-taker's instrument, seen through his optical square, coincides with the target viewed directly. He now shouts "On," when the range-taker adjusts his micrometer-screw so as to bring the mark on the other instrument into coincidence with the target, and then the reading on the graduated scale gives the range.

For objects in motion the range-taker remains steady, while the right-angle man, as far as possible, continuously shifts his position so as to keep the mark on the range-taker's instrument and the target in coincidence. In cases of rapid motion at right angles to the line of sight, difficulties are experienced in keeping continously "on," and in such cases the right-angle man shouts "On" whenever the mark passes the target, and the range-taker then seizes the opportunity of taking the range.

There are several serious objections to two-observer instruments. In the first place, they cannot be used for the measurement of the distances of sky-lines, trenches, hedges, &c., of a more or less horizontal character, with no prominent vertical features about them. Secondly, it not infrequently happens that the two observers are working on different objects altogether or on different portions of the same object, in which case an entirely fictitious range is obtained. Most important of all, they necessarily expose the range-takers. It has been stated that several casualties have occurred in South Africa among men engaged in range-finding. Under such conditions as those pertaining in South Africa, it is obviously most risky to expose men in the open. Single-observer instruments are free from all these defects.

(2) *Depression Range-finder.*—If we have a vertical base, and if the target is constrained to move in a horizontal plane, we may dispense with the right-angle man altogether. The only case where this plan can be adopted in practice is when we wish to determine the range of a ship from a hill near the coast. The base-line is now the vertical height of the observing station above sea-level, and the range is obtained very simply by observing the angular depression of the water-line of the ship. Allowance has to be made for the effect which the tides produce in varying the equivalent height of the base. Unfortunately, the water-line of a ship—especially if the waves are at all high—forms an exceeding bad object upon which to observe, and this uncertainty can only be compensated by having a very long base—*i.e.* by having the range-finder at a very considerable altitude, say 150 feet or so. We therefore cannot use such an instrument on a flat coast, nor can we use it for determining distances at night, unless we can sufficiently well illuminate the water-line of a ship by means of a search-light.

(3) *Zeiss Range-finder.*—This is the first of the two single-observer instruments which it is proposed to describe in the prescribed limits of time. The credit of the idea underlying the construction of the instrument is due to the late Herr Grousillier of the German Army, but as the firm of Zeiss, of Jena, have spent many

[1] An evening lecture delivered at the British Association meeting at Bradford by Prof. W. Stroud.

years in working out the details of the instrument, it will probably be known in the future by their name. In the tele-stereoscope of Helmholtz two parallel reflectors are placed with reference to each eye, in such a position as to produce the optical equivalent of an increase in distance between the two eyes. Then when we look into the instrument at a distant landscape we shall get the appearance shown in Fig. 1. If this picture be viewed stereoscopically we shall obtain a mental impression as to the distance of any part of the landscape by comparison with the marks, and in this way get its approximate range.

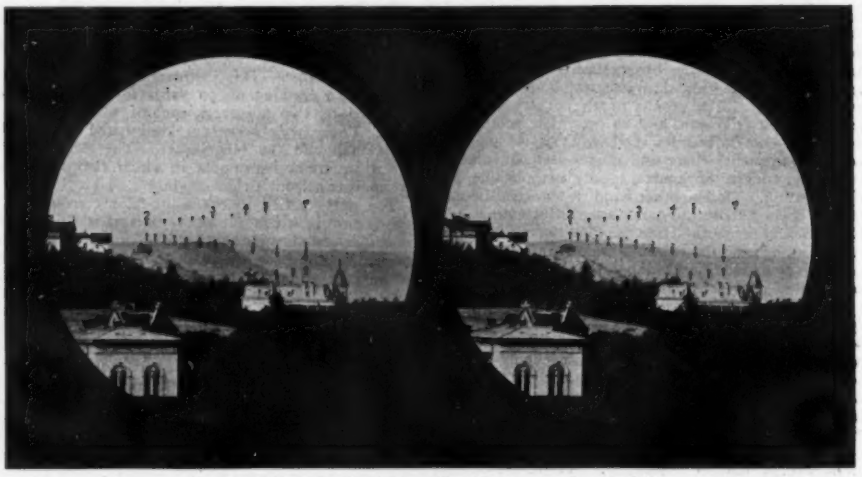


FIG. 1.—Field of view in the Grousillier-Zeiss stereoscopic range-finder.

This increases the stereoscopic effect. In the next place, by placing a telescope before each eye (and the two telescopes may conveniently be incorporated in the frame-piece supporting the reflectors), we multiply the stereoscopic effect still further, *e.g.* if the distance between the eyes has been artificially increased tenfold by the reflectors, and if the telescopes magnify tenfold, the stereoscopic effect will be increased altogether one hundred-fold. In this way immense stereoscopic solidity is imparted to the picture in the field of view.

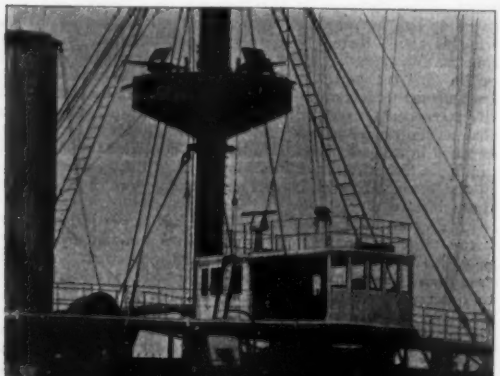


FIG. 2.—Bridge of H.M.S *Royal Sovereign*, showing Barr and Stroud range-finder on the top of the chart-house.

This instrument may be adapted to range-finding in the following way:—Suppose we imagine for the moment the instrument fixed, and that we see in the field of view of each eye the image of a pole 1000 yards away. Let permanent marks be made in the focal plane of each telescope exactly coincident with these images. Then, whenever we look into the instrument we shall apparently see a pole at a distance of 1000 yards. Let a similar pair of marks be fixed corresponding to 1100 yards, and so on. The instrument is highly ingenious and very pretty, and it will no doubt offer a solution of the problem of military range-finding should it prove sufficiently accurate in practice.

(4) *B. and S. Naval Range-finder.*—This instrument, with a base of 4½ feet, has been adopted in her Majesty's Navy, and

FIG. 3.—Barr and Stroud range-finder on fortress mounting.

nearly all the larger ships are now equipped with one or more of them. Fig. 2 shows a view of the charthouse of H.M.S. *Royal Sovereign*, on the top of which the range-finder will be seen near the Kelvin compass.

This instrument, in favourable circumstances of weather, will measure ranges in a few seconds of time with an accuracy of something like 3 yards at 1000 yards, 30 at 3000, 120 at 6000, and so on. Prof. Barr, of the University of Glasgow, and the lecturer devised the instrument in its main features in 1888; it took, however, a period of five years to make a satisfactory naval instrument, and for the past seven years the improvement of the optical and mechanical details has been going on.[1]

Fig. 3 shows the same instrument mounted for fortress observation.

It is claimed for these instruments that they offer a solution—of course not necessarily the only or the best—of the problem of range-finding in all cases where want of portability is not a drawback.

B. and S. Field Range-finder.—Fig. 4 shows a smaller instrument of the same type with a base of 3 feet, which weighs 12 lbs. One of these instruments has been used by Major Guinness in South Africa since the beginning of February, and that officer reports that after carrying the instrument on his ammunition wagon over all sorts of ground for six months it was in no way damaged or deranged. The figure shows how

FIG. 4.—Barr and Stroud field range-finder.

the range-finder can be used for taking a distance with practically no exposure of the man.

The lecturer concluded by describing and exhibiting the electrical telegraph for naval use which Prof. Barr and he had devised at the request of the Admiralty, so as to enable the captain of the ship in the conning tower to receive from the range-taker continuous records of the enemy's distance and to transmit the same and also orders to the guns. The importance of trustworthy means for transmitting orders and other communications from one station to another on a war-ship is now fully realised. Thus, for example, it is reported that in the opinion of Admirals Fournier and de Beaumont and the officer in command, the loss of the French torpedo-boat destroyer *Framee*, which occurred about a month ago, was due to the fact that the apparatus on board the vessel for the transmission of orders was inadequate. The need for continuous and almost instantaneous transmission of ranges to the gunners will be obvious when it is remembered that in naval engagements the range is continually and rapidly altering.

The lecturer concluded by expressing his thanks to Mr. J. J. Hicks, of London, Mr. Steward, of London, and Messrs. Zeiss, of Jena, for the loan of range-finders to illustrate the lecture.

[1] Readers unacquainted with the instrument are referred for details of its construction to *Transactions* of Inst. of Mech. Eng. (1896), or *Engineering*, 1896 Part i. p. 233, &c.

MECHANICS AT THE BRITISH ASSOCIATION.

ALTHOUGH no very striking paper was presented to the section at this meeting, still several papers of value and of considerable interest were dealt with.

In the committee of the section two very important pieces of work were carried out. The committee on small screw gauges, which has now been at work for some years, presented an interim report in which the difficulties the committee had met with in obtaining standard gauges were very fully discussed, and an account of some experiments on different forms of threads, made by Mr. T. M. Gorham and Mr. W. A. Price in the laboratory of Prof. Hudson Beare at University College, London, were described. The committee stated in their report that they have now every hope of bringing their inquiry to a successful conclusion, and the committee was therefore re-appointed and a grant was secured for the necessary expense of completing the work.

A committee was also appointed at Bradford to deal with the question of the resistance of road vehicles to traction. Prof. Hele Shaw read a short paper before the section, drawing attention to the need of modern experiments on the nature of the resistances encountered by vehicles on the common road. He pointed out how the growth of the cycle and motor car industry made information upon this point a matter of the greatest importance.

There is no doubt that we are on the eve of a very considerable increase in mechanical propulsion on common roads, and at present designers of such vehicles have to rely largely upon old experiments with solid steel tyres, and carried out on roads very different indeed from the modern roads. The powerful auto cars which can now be obtained make it comparatively an easy matter to determine the tractive power necessary to move a vehicle with any load upon any type of road, and no doubt the work of the committee will largely consist—after a suitable dynamometer and speed indicator have been arranged for—in carrying out exhaustive experiments with different types of vehicles and different types of tyres on all the various classes of roads now in use.

A grant of money was secured from the Association for the purposes of this committee, and we have every hope that when the committee submits its report it will justify its appointment.

In the work of the section papers by local engineers bulked largely. Perhaps the two most interesting and valuable were a paper by Mr. J. Watson, the Waterworks engineer at Bradford, in which the new Nidd Valley Waterworks were described, and the paper by Mr. J. MacTaggart, the Superintendent of the Cleansing Department of the City of Bradford, entitled "The Disposal of House Refuse in Bradford."

In Mr. Watson's paper a short historical summary of the various schemes for supplying Bradford with water was given, followed by a very exhaustive and complete account of the Nidd Valley scheme. This scheme, now rapidly approaching completion, is one which will cost the City of Bradford nearly 1,500,000*l.* and will afford a supply of about twenty million gallons of water per day, and in addition will provide a large compensation reservoir (Gouthwaite) for the land-owners along the Nidd Valley.

It is essential for such a city as Bradford, where the chief industry is that of the woollen trade, that the water shall be very soft, and, of course, this led to some difficulty in finding a suitable collecting ground for the city supply.

The section had the opportunity of visiting, under the guidance of Mr. Watson, portions of the works on the Saturday of the meeting.

In Mr. MacTaggart's paper very valuable information was given as to the most modern methods in a big manufacturing city for the disposal of the daily city refuse. So successful have the various arrangements been, mostly due to the author, that it is hoped in time the destruction of the whole of the refuse of the city will be carried out, not only without creating any nuisance, but without any cost to the ratepayers. The refuse is chiefly dealt with by destructors, and the great merit of the Bradford system is in the utilisation of the clinker produced in the destructor furnaces for various useful purposes, the power to work the machinery required for these purposes, and the lighting of the works all being obtained from the steam generated by the surplus heat of the destructors. A large number of specimens were shown to the section of concrete paving-slabs,

bricks and encaustic tiles manufactured from the clinker, and some interesting figures as to the strength of these materials were also given.

Another paper by a Yorkshire engineer, Mr. E. K. Clark, dealt with the subject of the shop buildings in large engineering works. The author had collected a large amount of statistics and figures, both as to the method of construction now generally adopted—viz., the shops all on one level—and as to the materials commonly used in their construction, and the paper will form a very valuable reference for any engineer engaged either in laying out new engineering workshops, or in reconstructing old buildings.

Mr. Glass contributed a lengthy paper dealing with the coal and iron ore fields of Shansi and Honan, and railway construction in China. The author was engaged in 1898 by a syndicate to proceed to China, and to examine and make a complete report on the coal and iron-ore fields of these two important provinces of China, and also to make surveys for the railways which it would be necessary to construct in order to utilise these deposits.

An interesting description was given of the general features of the country, illustrated by some beautiful lantern slides from photographs taken by the author, and also a very complete account of the Chinese method of working these mineral deposits. The author stated that it was somewhat difficult to arrive at very exact estimates of the quantity of coal available in these great fields, but it is believed there are more than 33,000 square miles of coal-fields in Shansi alone, and that the present output of Great Britain, which is more than 200 million tons a year, could be maintained from the anthracite coal-fields of Eastern Shansi alone for a period of 3000 years.

Samples of the coal have been analysed and show that it is a good steam coal.

Similar favourable accounts were given in regard to the iron ore deposits, and the author computed that it would be possible to produce a ton of pig-iron from these ores at the very low cost of 12s. 1½d. per ton, assuming labour to be at the same rate as it is now at Middlesbrough in England. The lowest price at which the pig-iron was being sold at the foundries visited by the author was a little over 20s. per ton.

The extraordinary richness of these mineral deposits and the enormous area awaiting development show how pressing the problem of reorganising peacefully the internal government of China is for the civilised world.

On the day devoted to electrical engineering, two short communications were read by Sir Wm. Preece and Mr. F. J. Behr, dealing with the proposed Monorail High Speed Electric Line between Manchester and Liverpool.

It will be remembered this scheme came before Parliament last session and was rejected, largely owing to the strenuous opposition of the existing railways.

The interesting feature in these papers was the account given of the brakes and signals which it is proposed to adopt, which must be an important matter on a line where it is proposed to run the trains at frequent intervals, and at such an excessively high speed as 110 miles per hour. Perhaps if the promoters had been content to reduce the proposed speed somewhat at the beginning, their scheme might have been more favourably considered.

A valuable paper dealt with on this day was one on the measurement of the tractive force, resistance and acceleration of trains, by Mr. A. Mallock. The author described the apparatus which he used for the purpose, and gave an account of some experiments which he has recently carried out on these important questions. He concluded from his results that pendulum observations combined with a record of speed and power offer a simple and effective means of determining the resistance to and efficiency of electric or other kinds of motor vehicles.

On this day also, a communication from Mr. W. T. E. Binnie, a son of the president, was read, describing a new form of self-registering rain-gauge which he has invented. The accuracy of the gauge depends on the fact that all drops falling from a tube are of constant size, provided that the tube is either very small so that the water passing down the interior chokes the bore, or that some special device is provided to spread out the water so as to wet the entire circumference of the tube. If, therefore, the weight of each drop were ascertained, it is clear that a measure of the amount of water passing down the tube would be obtained by counting the number of drops, and the electrical appliances are concerned with this part of the work.

An instrument made on this principle has been in operation for some time, and the records obtained from it in a period of five months give a total excess of 1·6 per cent. over the register of an ordinary rain-gauge.

Mr. W. Dawson contributed a paper descriptive of the Demerbe system of tramway construction, a system which has been tried on the Bradford Corporation tramways and found very successful in the reduction of the cost of permanent way repairs. In the Demerbe system the rail consists of a hollow trough and the fish plate is placed inside under the ends of the rails and exactly fits its contour, the fish-plate being forced into close contact with the under side of the rail by driving in two cotters. The rail, when laid in position, is completely filled, by means of specially-designed tools, with concrete. The tie bars are flat and very simply arranged, and the gauging of the rails can, therefore, be done rapidly with almost mathematical exactitude.

The system certainly seems to have considerable merits compared to the girder system of tram rails.

Two other instruments described in short communications were a combination integrating wattmeter and maximum demand indicator, the invention of Mr. J. H. Barker and Prof. Ewing, and a new form of calorimeter for measuring the wetness of steam, designed by Prof. Goodman.

The former instrument is designed to measure two quantities, the total amount of electricity used by a consumer and the maximum number of lamps or their equivalent ever lighted at one time. By this means it is possible to grade the charges for electric energy, and it enables the consumer to be charged at a lower rate for current he may use over and above the units which would have been used had the largest number of lamps in his installation burnt for one hour every day during the whole period the current was in use.

Prof. Goodman's instrument is intended to get over some of the more serious difficulties in measuring the wetness of steam supplied by any boiler. He discards entirely the wire-drawing system, and determines the wetness by condensing a known weight of the mixed steam and water in a known weight of cold water, and measuring the rise of temperature.

Prof. Beaumont, of Leeds, in a most interesting paper described the photographic method of preparing textile designs due to Szczepanik, a number of designs being shown which had been produced by this process.

In continuation of a paper which was read before the Association at Liverpool in 1896, Mr. A. T. Walmisley gave further information as to the use of expanded metal in concrete work, and gave particulars of a number of important tests which have been carried out to determine the increase of strength and the adhesion between the concrete and the metal.

The attendance at the sectional meetings was very good, and the president, Sir Alexander Binnie, may be congratulated on a successful and useful meeting.

BOTANY AT THE BRITISH ASSOCIATION.

IN the absence of Prof. Vines the presidential address was read by Dr. D. H. Scott. On the motion of Prof. Bayley Balfour, supported by Prof. Marshall Ward, Prof. Bower and other speakers, it was unanimously agreed to ask the Recorder of the Section to convey to Prof. Vines the sincere regret of the Botanists that he was prevented by illness from presiding over their meeting.

The customary semi-popular lecture was this year delivered by Prof. Percy Groom, who chose for his subject "Plant-form in relation to nutrition."

On Monday, September 10, the Section of Geology joined Section K in a discussion on the conditions under which the plants of the Coal Period grew. The discussion was opened by Mr. Kidston (Stirling), who gave a general account of the flora of the Coal-measures, illustrated by a series of excellent photographs of the various types of Upper Carboniferous plants. Mr. Seward dealt with the botanical evidence bearing on the climatic and other physical conditions under which coal was formed. On the geological side the discussion was opened by Mr. Strahan and Mr. Marr. Dr. Horace Brown discussed the question of the possible richness in CO_2 of the coal period atmosphere, and gave an account of some of his recent experiments with plants grown in an atmosphere containing twice or thrice the present amount of carbonic acid gas. Dr. Scott, Dr. Blackman, and Prof. Hartog also took part in the discussion from the botanical standpoint.

GENERAL.

Prof. Bower, F.R.S, gave an account, illustrated by several excellent photographs, of sand-binding plant as seen in the dunes on the Scotch coast in the neighbourhood of North Berwick.

British sylviculture, by Samuel Margerison. In this communication attention was called to the large importation of foreign timber, and the urgent need of Government aid in the production of British timber. The author spoke of the existence of much land in this country at present unproductive, or only slightly productive, which is suitable for giving a native supply of timber. He compared the results of Continental and British sylviculture, and pointed out that in Britain the natural conditions are not less favourable, but the management is generally inferior. The author urged the importance of encouraging forestry schools which should afford opportunities for detailed research and teaching, with equipment, scientific and practical, worthy of the subject.

The great smoke-cloud of the North of England and its influence on plants, by Albert Wilson. The author spoke of the extent of the great smoke-producing district of the North of England and the miserable condition of the vegetation in some parts of the area. Among the various points dealt with in the paper, the following may be mentioned, the long distance reached by the smoke of large towns; the discoloration of rain-water ("black rain"); the effect of smoke on mosses and hepatics as compared with that on higher plants; the threatened extinction of *Ulota* and *Orthotricha*; the influence of smoke on sunshine and air-temperature in calm summer weather and in anti-cyclonic weather during autumn or winter.

Embryonic tissues, by Prof. Marshall Ward, F.R.S. The author urged the advisability of improving the current terminology with regard to the nature and growth of the tissues termed embryonic. Sachs termed all the tissues of the growing-points, cambium, pericycle, &c., embryonic tissues. Prof. Ward would restrict the term *embryonic tissue* to that of the embryo alone before the desmogen strands are developed, the other tissues being designated *derived* or *secondary tissues*. The tissues of the growing-points are derived from embryonic tissue, and differ from it in that, instead of being capable of developing all or any part of the plant, they are more or less restricted to the power of developing shoots, leaves, &c., or only roots. The proposed classification would apply equally to the lower organisms; some of the Algæ and Schizomycetes appear to be always in the embryonic stage. Prof. Ward also urged the desirability of distinguishing between the *assimilatory* growth of true embryonic tissues and the *vacuolar growth* of the derived tissues.

PHYSIOLOGY.

Dr. F. F. Blackman and Miss Matthaei communicated the results of their recent work on the effect of the closure of stomata on assimilation; Dr. Blackman also gave an account of his investigations on the so-called optimum strength of CO_2 for assimilation.

Formation of starch from glycollic aldehyde by green plants, by Henry Jackson. Glycollic aldehyde has lately been isolated in a crystalline state, and more recently it has been shown by the author that this substance, under the influence of dilute alkalis, very quickly condenses to two synthetic hexoses. Leaves of *Tropaeolum* and clover, which had been depleted of their starch by growing in the dark, were floated in a three per cent. aqueous solution of diose, control experiments being made with cane-sugar, glycerine and distilled water, the whole series being kept in the dark for six days. They were then tested by Sach's method; those floating in pure water were quite starchless, those in glycerine almost so, but those growing in diose had accumulated starch in the tissues, though not to the same extent as those placed in cane-sugar.

On the effect of salts on the CO_2 assimilation of *Ulva latissima*, L., by E. A. Newell Arber. It was found that an inhibition of the power of CO_2 assimilation could be caused by the presence or absence of certain salts in the medium. *Ulva* was obtained free from starch and exposed to light in various media. In distilled water only a very small amount of starch was formed, while in tap-water containing traces of nutrient salts the inhibition was only partial. The presence of NaCl in the medium was found to be essential in order to obtain the maximum of CO_2 assimilation. A total or almost total absence of NaCl caused a very marked inhibition, and no other salt could be found to replace NaCl in regard to CO_2 assimilation. The absence from sea-water of any one of the following salts, $MgCl_2$, $MgSO_4$, $CaSO_4$, or KCl, did not inhibit the assimilation. The presence of a nitrate in appreciable quantity in the medium caused an inhibition.

The sea-weed *Ulva latissima* and its relation to the pollution of sea-water by sewage, by Prof. Letts and J. Hawthorn. For a number of years past a very serious nuisance has arisen from the sloblands of the upper reaches of Belfast Lough during the summer months, the stench at low-tide being quite overpowering, and the air heavily charged with sulphuretted hydrogen.

The nuisance is caused by deposits of the green sea-weed, *Ulva latissima*, which in the two localities mentioned grows in abundance, and during high winds or gales is washed ashore. In Belfast Lough the quantity thus deposited is enormous. Once deposited, these layers of sea-weed often remain more or less stationary for months in the shallow bays or pools of the neighbourhood, and in warm weather rapid putrefaction occurs, and a perfectly intolerable stench arises, which is perceptible over a wide area and seriously affects, not only the comfort of the inhabitants of the district, but also the value of their property.

The evidence which the authors have collected tends to the conclusion that the occurrence of *Ulva latissima* in quantity in a given locality is an indication of sewage contamination, and there can be no doubt as to the power which the weed possesses of absorbing nitrogen compounds from polluted sea-water. While thus acting as scavenger it may itself give rise to a very extensive nuisance.

Further investigations on the intumescences of *Hibiscus vitifolius*, L., by Elizabeth Dale. In a previous paper (*Proc. Phil. Soc. Camb.* vol. x. 1900, p. 192) the author gave the results of some experiments, which pointed to the conclusion that the conditions determining the formation of the outgrowths were moisture, warmth and light. More recent work has given the following results: (1) In a moist atmosphere, bright sunlight and a high temperature, large numbers of intumescences were formed in two or three days; (2) outgrowths were produced under red, yellow and white-washed glass, but not under blue or green glass; (3) the distribution of outgrowths is dependent upon that of the stomata; (4) the checking of transpiration in a damp atmosphere is one cause of the development of the outgrowths, but this in itself is insufficient. There is further evidence that an altered course of metabolism is also involved.

ANATOMY, PALÆOBOTANY, &C.

On a fourth type of transition from stem to root-structure occurring in certain monocotyledonous seedlings, by Ethel Sargant. Van Tieghem described three types of transition from a stem to a root-structure (*Traité de Botanique*, 1891, p. 782). Miss Sargant found a fourth type in certain monocotyledonous seedlings. The best example is *Anemarrhena asphodeloides*, but there are very clear traces of the same structure in some allied genera. In *Anemarrhena asphodeloides* there are two bundles in the cotyledon which pass downwards through the hypocotyl into the primary root. During the transition each phloem group divides into two. Each xylem group branches in three directions. It sends a group of protoxylem elements to divide its own two phloëm groups from each other. Two lateral protoxylem groups are also formed from the xylem of each bundle in the space dividing the bundles from each other. The four lateral protoxylem groups thus formed are reduced to two by the fusion of adjacent groups in pairs. In the end, there are four phloem groups and four protoxylem groups in the root-stele.

On the presence of seed-like organs in certain Palæozoic lycopods, by Dr. D. H. Scott, F.R.S. Specimens discovered by Messrs. Wild and Lomax in the Lower Coal-measures of Lancashire prove that the seed-like bodies described by Williamson under the name of *Cardiocarpon anomalum* were borne on strobili, agreeing with *Lepidostrobus*. Each megasporangium, which was seated on the upper surface of the sporophyll, became enclosed, when mature, in an integument springing from the tissue of the sporophyll-pedicel. The integument closed in over the top of the sporangium, leaving only a narrow crevice or micropyle, which differed in its elongated, slit-like form from the more or less tubular micropyle of an ordinary seed. Within the megasporangium four megaspores were produced, one of which occupied almost the whole of the sporangial cavity, while the other three remained small, and were evidently abortive. The integumented megasporangium, containing the single functional megaspore or embryo-sac, became detached, together with the remains of its sporophyll, from the cone. It appears to have

been indehiscent, and presents close analogies with a true seed. In a male strobilus, probably of the same species as the specimens above described, the microsporangia were found to be provided with integuments, resembling those of the megasporangia, but more widely open.

It is proposed to give the generic name *Lepidocarpon* to this Lepidostroboid fructification.

The primary structure of certain Palæozoic stems referred to *Araucarioxylon*, by D. H. Scott, F.R.S. The Palæozoic forms of *Araucarioxylon* have been shown to belong in most cases to the stems of the extinct Gymnospermous order Cordaiteæ, which was in some respects intermediate between Cycadales and Coniferæ. The Cordaitean stems hitherto investigated resemble Coniferæ in the development of their wood, for the spiral first-formed tracheides are found in contact with the pith, the whole of the wood, primary as well as secondary, having thus been developed in centrifugal order. The specimens of Lower Carboniferous age now illustrated are peculiar in possessing distinct strands of primary wood in the pith. In one, *Araucarioxylon fasciculare*, sp. nov., the pith is small, but the primary strands of xylem are of large size, attaining their maximum diameter when about to pass out towards a leaf. Their structure is mesarch, and they closely resemble the corresponding strands in *Lyginodendron Oldhamium*. The secondary wood has narrow medullary rays, and resembles that of an araucarian Conifer. The other species is identical with *Araucarioxylon antiquum* of Witham. The interest of the two species (described from specimens in Mr. Kidston's collection) consists in their affording a link between certain of the Cycadofilices and the Cordaiteæ.

On the structure and affinities of *Dipteris conjugata*, with notes on the geological history of the Dipteridinæ, by A. C. Seward, F.R.S., and Elizabeth Dale. The genus *Dipteris* is represented by four recent species: *D. conjugata*, Reinw. [= *Polypodium* (*Dipteris*) *Horsfieldii*, R. Br.], *D. Wallichii*, R. Br., *D. Lobbiana*, Hk., and *D. quinquefurcata*, Baker. Among Mesozoic ferns the genera *Protorhipis*, *Dictyophyllum* and *Camptopteris* afford examples of extinct types closely allied to *Dipteris*, and widely spread geographically during the Jurassic epoch.

The sporangial characters of *Dipteris* do not conform precisely to those typical of the Polypodiaceæ, and the anatomical features afford additional evidence in favour of placing *Dipteris* in a special subdivision of the leptosporangiate ferns.

The paper dealt with the structure of the stem, which possesses a single annular stele, the roots, leaves and sporangia of *Dipteris conjugata*, the comparison of the anatomical features with those of the Cyatheaceæ and other ferns, and concluded with an account of the geological and geographical range of such fossil ferns as may reasonably be placed in the family Dipteridinæ.

On the structure of the stem of *Angiopteris evecta*, Hoffm., by R. F. Shove, Girton College, Cambridge. This paper dealt with the anatomy of the stem and roots of a plant of *Angiopteris evecta* from Ceylon.

The steles of the stem are both mesarch and endarch in structure, but the protoxylem groups occupy for the most part a peripheral position. The earliest protoxylem appears along the inner edge of the steles, while the protophloem arises on the outer edge of each stele as a discontinuous arc of small and rather thick-walled elements. This arc of protophloem is never completed round the stele, but the next stage in the development of the tissues after the appearance of the protoxylem is the differentiation of large sieve-tubes external to the protophloem.

The conducting tissues of Bryophytes, by A. G. Tansley. The most important part of our present knowledge of these tissues is due to Haberlandt, who, in the Polytrichaceæ, distinguished a *hadrom* (*hydrom*) or water-conducting system from a *leptom* system, conducting plastic, especially nitrogenous substances.

In the present investigation the lignified strand of prosenchyma in the thallus of certain Liverworts was shown to be a hydrom strand, and its development was considered to be correlated to some extent with the localisation of the absorptive region of the thallus.

The rhizome of four species of *Polytrichum* was investigated, and was found to possess the distribution of tissues characteristic of the root of a vascular plant. The transition to the structure of the aërial stem was followed, and some new points in the structure and course of the leaf-traces were observed; new light was thrown also on the constitution of the Polytrichaceous stele, which is thought to consist of two regions distinct in function and by descent. An attempt was made to trace out the course of evolution of these conducting tissues in the Bryophytic series.

The origin of modern Cycads, by W. C. Worsdell. The author's conclusion is that the Cycads are descended directly from some cycado-filicinean type possessing the structure exhibited especially by such forms as the Medulloseæ and Lyginodendreæ, the chief point being that the *collaterally*-constructed one or more vascular cylinders of modern cycads have been derived from one or more *concentrically*-constructed cylinders of some cycado-filicinean form. Those characters in the modern plants which approximate most nearly to the primitive ancestral type are found in those parts of the plant where they would most naturally be expected, viz.:—The *axial* organs: the *primary node* or transitional region between stem and root, and the *flowering axis*; the *foliar* organs: the *cotyledon*, the *sporophyll*, and the *integument* of the sporangium. The author discussed the evidence derived from an anatomical study of recent cycads, and dealt with certain fossil types which he regarded as supporting his conclusions.

CYTOLOGY, &c.

On the osmotic properties and their causes in the living plant and animal cell, by Prof. Overton. A very great number of experiments on the permeability or the living protoplasm of plant and animal cells has led to the conclusion that the general osmotic properties of the cell depend on a phenomenon of *elective solubility*, certain layers of the protoplasm being impregnated with a mixture of lecithin and cholesterin. All substances that are soluble in this mixture, and they include by far the greater number of organic compounds, being able to penetrate into the living cell. The rapidity of the passage of different compounds into the cell depends on their relative solubility in water and in a mixture of cholesterin and lecithin. A knowledge of the osmotic properties of the living protoplasm throws much light on the action of many poisons and other drugs.

Demonstration of the structure and attachment of the flagellum in *Euglena viridis*, by Harold Wager. The flagellum of *Euglena viridis* possesses a bifurcate base, which is attached to the wall of the excretory reservoir at the anterior end of the body (*Journ.* Linn. Soc. Zool. vol. xxvii. p. 463). As it passes to the exterior through the gullet, an enlargement occurs in the region of the eye-spot. This structure can be seen in very favourable cases in the living condition, but usually only after the action of reagents. The best reagents for this purpose are either a 1 per cent. solution of osmic acid or a 2 per cent. solution of bichromate of potash with a 1 per cent. solution of osmic acid. The structure may be obscured by small grains of paramylon, which sometimes accumulate at the anterior end of the body.

The behaviour of the nucleolus during karyokinesis in the root-apex of Phaseolus, by Harold Wager. From a study of the changes undergone by the nucleolus during karyokinesis in cells of the root-apex of *Phaseolus multiflorus*, the following chief results have been obtained.

(1) The nucleolus is the most conspicuous object in the nucleus of the young meristematic cells. The nuclear network forms a delicate peripheral layer only in the resting nucleus. (2) The nucleolus stains deeply in hæmatoxylin, the nuclear network slightly; in safranin and gentian violet the nucleolus stains red, the nuclear network light blue. (3) In the resting condition of the nucleus the nucleolus is suspended to the nuclear network by delicate filaments. (4) The nucleolus often shows a vacuolar structure. (5) In the process of nuclear division the nucleolus first of all becomes irregular in shape, and the nucleolar substance appears to pass, by means of the connecting strands, into the nuclear network, which thereby becomes more prominent. (6) As the chromosomes are formed the nucleolus disappears, but a portion of the nucleolus is often visible in the equatorial plate. (7) The chromatic substance of the chromosomes appears to be derived almost entirely from the nucleolus. (8) As the daughter-nuclei are being formed the chromatic substance of the chromosomes runs together into small spheres, which ultimately fuse to form the single large nucleolus.

On double fertilisation in a dicotyledon, *Caltha palustris*, by Ethel N. Thomas. The polar nuclei of this plant unite before fertilisation, but that there is no absolutely fixed period is shown

by the very different appearance of sacs in which polar fusion is taking place. The male generative nuclei, when first set free in the embryo-sac, are extremely small and heavily stained. Their chromatic substance is so densely aggregated as to render the spermatozoid to all appearance homogeneous. Of the two spermatozoids one passes to the middle of the sac and there *fertilises the definitive nucleus*; the other fertilises the nucleus of the oosphere. By the time the male generative nucleus or spermatozoid has reached the definitive nucleus, it has enlarged immensely, and shows a light spongy structure with scattered chromatin granules. The other spermatozoid increases very little in size, and always remains dark and dense.

When the spermatozoids leave the pollen-tube they are somewhat short and thick, and only slightly curved, but when the one has approached the definitive nucleus, it has the typical vermiform shape, with one or several coils.

THALLOPHYTA.

Germination of the zoospore in Laminariaceæ, by J. Lloyd Williams. The zoospore comes to rest and becomes spherical. The single chloroplast divides in two. A tube is produced, the spore-contents pass into it. At the end of the tube a swelling is formed, into which the contents migrate and are shut off from the empty spore-case and tube by a wall. This has been wrongly described by Areschoug in the case of *Dictyosiphon* as an instance of sexual fusion. In the enlargement, the chloroplasts multiply, and additional eyespots appear on several, which, however, disappear after a few days. The newly-separated cell now divides, and forms a branched protonema-like structure.

Notes on *Dictyota*, by J. Lloyd Williams. The factors concerned in the production of the fortnightly crops of sexual cells were discussed. Experiments on the liberation of antherozoids show the importance of bright light and cool temperature. *Dictyota* is particularly responsive to changes in the environment.

The nuclear changes in the unfertilised eggs are peculiar. The chromosomes are differentiated, a very irregular multipolar spindle is formed; this separates into a number of nuclei of various sizes, in which at first the chromosomes are scattered. These soon disappear, the nucleoli are formed, and the nuclei appear in the resting condition.

The *Azygospores* of *Entomophthora gloeospora*, by Prof. Vuillemin (Nancy) (communicated by Prof. Hartog). The genus *Entomophthora*, as seen in the two species *E. Delpiniana* and *E. gloeospora*, shows an intermediate condition between *Basidiobolus*, with its uninucleated segments, and *Empusa*, with its continuous hyphæ with scattered nuclei. The resting-spores of *Entomophthora* may be terminal, lateral or intercalary. The youngest spores contain a single nucleus, which undergoes a series of four successive binary divisions until there are sixteen; there may, however, be irregularities as regards the number of spores. In the next stage the nuclei approach so as to form eight pairs, and the two nuclei of each pair then fuse; this fusion is repeated until there are only two left. These last two may then fuse at once, so as to leave the now maturing azygospore with a single nucleus, or they may remain apart. This manner of development is interpreted as a case of true apogamy, and regarded as corresponding to the sexual process in *Basidiobolus*.

Fungi found in Ceylon growing upon scale-insects (*Coccidæ* and *Aleurodidæ*), by J. Parkin. Fungi associated with scale-insects have till recently been little studied. A few species have been mentioned from time to time as growing upon scales of dead coccids, but, till within the last few years, hardly any attention has been called to their probable parasitic character, or to the possibility of their being employed to check the ravages of scale-pests. Webber in 1897 pointed out for the first time the parasitic habit of certain species—five in all—of *Aschersonia* on scale-insects infesting the orange and other plants in Florida. Zimmermann (Java) in the following year gave a preliminary account of a fungus (*Cephalosporium*) attacking the green bug (*Lecanium viride*), so harmful to the coffee, and described how it may be artificially cultivated for infecting experiments.

The various kinds dealt with were referred to the following genera:—*Nectria*, *Torrubiella*, *Aschersonia*, *Cephalosporium*, *Verticillium*, *Microcera*, *Campsotrichum* (?).

Mr. Parkin drew attention to the wide distribution, especially in and near the tropics, of fungi infecting scale-insects, and referred to them as the true cause of death of the insects. The paper was illustrated by a series of carefully-prepared specimens and drawings.

On the life-history of *Acrospeira mirabilis* (Berk. and Br.), by R. H. Biffen. Loose brown masses of the spores of this fungus are occasionally found in Spanish chestnuts. These spores are developed from the apices of hyphæ coiled into a spiral of, at the most, two turns, which becomes septate into three cells; the cell next below the apical one swells and becomes thick-walled, thus forming a chlamydospore. The coiled hypha may also develop into a spiral resembling the ascogonium of *Eurotium*, which, after investment by branches arising from its apex, breaks down into chlamydospores. In this way bodies very suggestive of the spore-masses of some of the Ustilagineæ are formed. Endoconidia are found in old cultures. Some evidence has also been obtained for the existence of an ascigerous stage.

On the structure of the root-nodules of *Alnus glutinosa*, by T. W. Woodhead. The nodules are traversed by a central strand of short, thick-walled fibres, with transverse pits in the walls. Surrounding this are 4–5 layers of cubical cells, rich in protoplasm, followed by a small-celled bulky cortex. On the outside of this is a phellogen, which produces a layer of cork several cells deep. The cortical cells are largely occupied by the organism which produces the nodule.

The organism is usually present as a globular sporangium at the end of a short hypha. Towards the base of the nodule are strands of cells occupied by disorganised contents indicating a previous tract of growth of the organism: this is succeeded by groups of cells filled with the organism in various stages. Towards the apex, and immediately behind the growing-point, the cells containing the sporangia are immediately followed by cells filled with fine hyphal filaments, which may be seen to penetrate the walls of the young adjacent cells.

A Gymnosporangium from China, by Prof. F. E. Weiss. This fungus was first observed by Dr. A. G. Parrott in the spring of 1899 in Lao-ho-kou, in North Central China. Its spore masses made their appearance in April after a few days' continuous rain on the branches of *Juniperus chinensis* in the form of bright yellow, gelatinous masses. The teleutospores are of the usual type, two-celled, tapering towards both ends and somewhat rounded at the apex. They possess eight germ-pores. What is in all probability the *Roestelia* stage of this fungus was observed during the summer on the leaves of the pear, *Pyrus sinensis*, Ldl. A tree of this species growing in proximity to the infected junipers was attacked by a fungus of the *Roestelia* type, producing typical æcidiospores.

In the appearance of its teleutospore masses this fungus appears most nearly related to *Gymnosporangium Sabinæ* (Dicks), a widely distributed form occurring in Europe and in America, and to *Gymnosporangium Cunninghamianum* (Barclay), a Himalayan form, both of which have their *Roestelia* stage on a pear.

The biology and cytology of Pythium, by Prof. Trow. The species described by the author was cultivated from conidia and oospores found in rotten cress seedlings. The study of pure cultures led to the following among other conclusions:—(1) No zoospores are produced under any circumstances. (2) The species is new and ranks as the most highly developed of the genus. (3) The fertilisation-tube penetrates the wall of the oogonium at a spot prepared for it, passes through the periplasm and penetrates deeply into the egg. One male nucleus passes down the tube and enters the egg. The oosphere clothes itself with a delicate wall and increases in size. (4) The fusion of the male and female nuclei is delayed until a thick oospore wall has been developed. (5) The nuclei multiply by indirect division in the mycelium and sexual organs. The only nuclear fusion is that of the male and female nuclei in fertilisation.

Observations on Pythium, by M. Poirault and E. J. Butler. The authors examined seven species, two of which were undescribed forms. In two species, *Pythium gracile* and *P. intermedium*, sexual organs were observed for the first time. Klebs' results on the dependence of spore-formation in *Saprolegnia* on external conditions were carried a step further, it being shown that a given spore could be induced to develop zoospores or vegetative hyphæ on appropriate treatment. The authors conclude that *Pythium* represents a stage in the colonisation of the land, by saprolegniaceous ancestors resembling *Aphanomyces*. It is closely linked to the *Peronosporaceæ* through *Pythium intermedium*, which possesses chains of gonidia, suckers, and a thick-walled mycelium.

Observations on some Chytridineæ, by M. Poirault and E. J. Butler. Four undescribed forms occur parasitic on *Pythium*. Their life-history has been worked out by the authors. *Chytridium gregarium* was found on the eggs of the rotifer *Metopidia Lepadella*; the unknown resting-spores were discovered. Observations were made on *Olpidiopsis Saprolegniae*. The infection takes place in the zoospore-stage of *Saprolegnia*, and is often multiple. Penetration takes place by a fine tube, through which the protoplasm of the parasitic zoospore enters the host, leaving behind an empty capsule. A. C. S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

OXFORD.—The following lectures are announced for the present term: Prof. R. B. Clifton, Acoustics; J. Walker, Double refraction; R. E. Baynes, Elementary mechanics of solids and fluids, and Mathematical theory of heat; Prof. W. Odling, Organic chemistry, metallic bodies; W. W. Fisher, Inorganic chemistry (preliminary course); J. Watts, Organic chemistry (honours course); V. H. Veley, Physical chemistry; J. E. Marsh, Stereochemistry; A. G. Vernon-Harcourt, The subjects of the preliminary examination (chemistry); P. Elford, Mendeléeff's periodic system. Introduction and group I; P. Elford, Chemists and their work; A. F. Walden, Origin, meaning and use of chemical symbols, formulæ and equations (elementary course); Prof. W. J. Sollas, Physical geography; Prof. W. J. Sollas, Jurassic fossils; Prof. H A. Miers, Elementary crystallography; H. L. Bowman, The metallic minerals; Prof. W. F. R. Weldon, General course of morphology (Coelentera); J. W. Jenkinson, Elementary morphology; E. S. Goodrich, Morphology of fishes; R. W. T. Günther, Polyzoa and brachiopoda; J. B. Thompson, Morphology of the ichthyopsida; J. B. Thompson, Ichthyopsidan palæontology; Prof. F. Gotch, General course of physiology, Part I. chemical processes; Prof. F. Gotch, Advanced course on muscle; J. S. Haldane, Subjects of the final honour school (physiology); G. Mann, Histology: G. J. Burch, Physiological physics; W. Ramsden, Introduction to physiological chemistry; G. Mann, Practical histology; W. Ramsden, Elementary physiological chemistry; Prof. S. H. Vines, Short elementary course (revision) with practical work; Prof. E. B. Tylor, Development of language, writing, arithmetic; H. J. Mackinder, The historical geography of the British Islands; H. J. Mackinder, The development of geographical ideas; H. N. Dickson, The atmospheric circulation; A. J. Herbertson, The geographic cycle; Sir J. Burdon-Sanderson, General pathology; Prof. A. Thomson, Anatomy of the nervous system; Prof. H. H. Turner, Elementary mathematical astronomy; Prof. A. E. H. Love, Gravitational attraction, and theory of the potential; and the theory of sound; Prof. E. B. Elliott, Theory of numbers; and substitutions and resolvents; Rev. F. J. Jervis-Smith, Dynamo and motor machinery and electrical testing; G. F. Stout, Child psychology; and the psychological development of the categories of subject, cause and end.

The electors to the newly instituted Wykeham Professorship of Physics will proceed to an election in November. Candidates are requested to send in their applications by October 24. The electoral body consists of the following:—The President of the Royal Society, Sir George Stokes, Prof. Esson, Prof. Odling, Mr. Hayes.

The Rev. E. C. Spicer, of New College, has been elected to the University Scholarship recently instituted in connection with the new School of Geography.

CAMBRIDGE.—The following is the speech delivered on October 11, by the Public Orator, Dr. Sandys, in presenting for the degree of Doctor in Science, *honoris causa*, Mr. Samuel Pierpont Langley, Keeper of the National Museum, Secretary of the Smithsonian Institution, and Director of the Astrophysical Observatory in Washington; the inventor of the "bolometer" and the "aërodrome."

Trans aequor Atlanticum ad nos nuper advectus est vir scientiarum in provincia insignis, qui etiam de astronomia recentiore librum pulcherrimum conscripsit. In urbe quod reipublicae maximae transmarinae caput est, viri huiusce curae multa mandata sunt: primum museum maximum rerum naturae spoliis quam plurimis ornatum; deinde institutum celeberrimum scientiae et augendae et divulgandae destinatum; denique arx et specula quaedam stellarum lumini in partes suas distribuendo dedicata. Luminis in spectro, ut aiunt, infra radios rubros radii alii qui oculorum aciem prorsus effugiunt, viri huiusce ingenio, instrumenti novi auxilio quod βολόμετρον nominavit, paulatim proditi et patefacti sunt. Nemo mirabitur virum stellarum observandarum amore tanto affectum, etiam e terra volandi desiderio ingenti esse commotum,—adeo ut, quasi alis novis adhibitis, plus quam trium milium pedum per spatium, etiam avium volatum aemulari potuerit. Fortasse aliquando, Icari sortem non veritus, etiam Horati praesagia illa sibi ipsi vindicabit:—

"non usitata nec tenui ferar
penna biformis per liquidum aethera."

Fortasse rerum terrestrium impatiens, rerum caelestium avidus, ausus erit e terris "volare

sideris in numerum, atque alto succedere caelo."

THE Senate of the reorganised University of London is now complete, and is constituted as follows:—Chancellor—The Right Hon. the Earl of Kimberley. Vice-Chancellor—Sir H. E. Roscoe, F.R.S. Chairman of Convocation—Edward Henry Busk. *Crown Members*—The Hon. W. Pember Reeves, Sir H. E. Roscoe, F.R.S., Mrs. E. M. Sidgwick, Sir John Wolfe Wolfe-Barry, F.R.S. *Faculty Members*—Theology—The Rev. Principal Alfred Cave. Arts—Prof. M. J. M. Hill, F.R.S., Prof. W. Paton Ker, Miss Emily Penrose, Prof. G. C. Warr. Laws—Lord Davey, appointed by the Crown. Music—Sir Charles Hubert Hastings Parry. Medicine—Dr. J. R. Bradford, F.R.S., Dr. J. Kingston Fowler, Dr. E. C. Perry. Science—Sir Michael Foster, Sec.R.S., Dr. William D. Halliburton, F.R.S., Prof. William Ramsay, F.R.S., Prof. A. W. Rücker, F.R.S. Engineering—Prof. W. C. Unwin, F.R.S. Economics, &c.—Prof. W. A. S. Hewins. Royal College of Physicians—Dr. W. H. Allchin, Dr. P. H. Pye-Smith, F.R.S. Royal College of Surgeons—Dr. A. P. Gould, Dr. H. G. Howse. University College—Prof. G. C. Foster, F.R.S., Lord Reay. King's College—Lord Lister, P.R.S., the Rev. Principal A. Robertson, D.D. Lincoln's Inn—Lord Macnaghten. Inner Temple—Judge Sir Alfred Marten, Q.C. Middle Temple—Mr. C. M. Warmington, Q.C. Gray's Inn—Mr. C. A. Russell, Q.C. Incorporated Law Society—Mr. W. Godden, Mr. R. Pennington. Corporation of London—Dr. T. B. Crosby. London County Council—Dr. W. J. Collins, Mr. Sidney Webb. City and Guilds of London Institute—Sir Frederic Abel. *Convocation Members*—Arts—Dr. J. Bourne Benson, Dr. J. D. McClure, Dr. T. Lambert Mears, Mr. J. Fletcher Moulton, M.P., F.R.S., Dr. T. B. Napier, Sir A. K. Rollit, M.P. Laws—Mr. Justice Cozens-Hardy. Music—Mr. J. W. Sidebotham. Medicine—Dr. Thomas Barlow, Dr. J. F. Payne. Science—Mrs. Sophia Bryant, Prof. Frank Clowes, Dr. C. W. Kimmins, Dr. F. S. McAulay, Sir Philip Magnus, Prof. Silvanus Thompson, F.R.S.

THE installation of the Earl of Rosebery as Lord Rector of Glasgow University has been fixed to take place on November 16.

PROF. BRUNHES, professor of physics in the University of Dijon, has been appointed director of the observatory on the Puy-de-Dôme.

MR. HOLBROOK GASKELL has given 1000*l.* towards the building and equipment of a new physics laboratory for University College, Liverpool.

MAJOR R. H. FIRTH has been selected to succeed Colonel J. Lane Notter, R.A.M.C., as professor of Military Hygiene at the Army Military School, Netley.

A FELLOWSHIP of the annual value of 100*l.*, for three years, will be awarded at Newnham College, Cambridge, in June 1901. Applications from former students of the college should be sent by May 1 to the Principal, from whom further information may be obtained.

THE Essex Museum of Natural History will be opened at West Ham this evening (October 18) by the Countess of Warwick; and the Municipal Technical Institute, which was destroyed by fire a few months ago, will be reopened by Mr. J. Passmore Edwards.

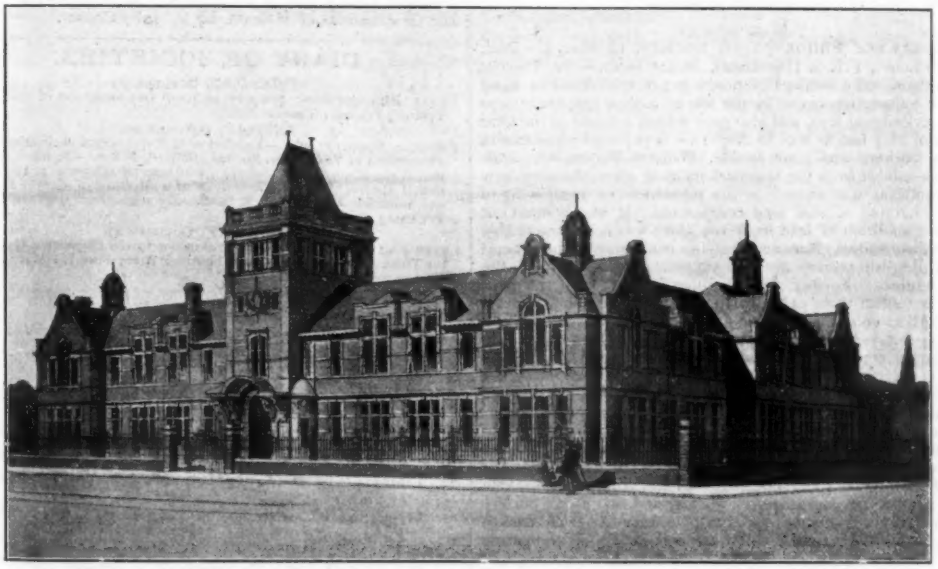
MR. T. GRAHAM YOUNG, son of the late Dr. James Young, F.R.S., has offered the sum of 10,000*l.* to the West of Scotland Technical College Building Fund, provided that certain conditions are fulfilled as to the site of the new College, the construction of a chemical department, and the completion of the building within five years of next January.

THE trustees of the College of the City of New York are, according to *Science*, considering the lengthening of the course to seven years. They have asked that the appropriation of 200,000 dollars made to the institution by the Board of Estimate and Apportionment be increased by 25,000 dollars.

THE Berlin University has, it is stated, decided to alter the conditions permitting foreigners to take the title of doctor of philosophy. Foreigners are only to be allowed to graduate if they hold certificates equivalent to that of the Humanistischer Gymnasium, Realgymnasium, or the Oberrealschule of the German Empire.

THE *Pioneer Mail*, Allahabad, states that a petition is about to be presented to the Lieutenant-Governor of Bengal asking that the Behar School of Engineering may be affiliated to the Calcutta University. "The one thing," the petitioners observe, "which has hampered the progress of the school in the past has been the uncertainty regarding its future. If Government will now settle the matter finally by raising the school to the status of a College, all obstacles in the way of the development of technical education in Behar will be for ever removed."

THE new Municipal Technical School which was opened by the Earl of Derby a few days ago, at Bootle, an enterprising borough on the borders of Liverpool, is shown in the accompanying illustration. Classes in science and technology have been held in Bootle since 1891, but the work has been very restricted on account of lack of adequate accommodation. The question of providing a special building for the work to be carried on and developed soon became a pressing one, and in 1897 a suitable site was obtained. In due course tenders were invited, and the handsome and convenient building here shown was erected at a cost of 22,065*l*. Four schools are to be accommodated in the building, viz. (1) the evening school, consisting of many science and commercial classes and some trade or technological classes; (2) a school of art, located in the upper rooms on the Balliol Road frontage; (3) a school of domestic economy placed in a special portion of the west wing; (4) a day-school for boys of twelve years of age and upwards, giving a course of instruction as nearly as possible on the lines of a good secondary or modern high school. The engineering department contains modern machines of workshop size, fitted up conveniently for demonstrating and teaching the essential workshop processes in engineering on a small but useful scale. Of course, a trade will not be taught, for commercial and industrial conditions cannot hold in a school; but care, accuracy, thought, possibly invention, may be developed by the teaching of the grammar of iron-work in the way indicated. In time it is hoped that this branch of the school will need extension and that it may then be possible to equip a mechanical laboratory provided with testing machines and demonstration appliances on a larger scale than can be used in an ordinary class room. As to the cost of carrying out this work under the new conditions, a sum of something like 700*l*. per annum will be required from the rates. Fees, grants and Imperial funds will in all probability contribute about 3,700*l*. per annum. Hitherto no rate has been levied for purposes of technical instruction, and the educational work has been entirely paid for from students' fees and Imperial grants.



The Municipal Technical School, Bootle.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, June 21.—"On the Spectroscopic Examination of Colour produced by Simultaneous Contrast." By George J. Burch, M.A., Reading College, Reading. Communicated by Francis Gotch, F.R.S., Professor of Physiology, University of Oxford.

It is well known that a neutral grey looks blue-green against a red ground and orange against a blue ground. This phenomenon may be spectroscopically investigated as follows:—

A square of red glass is inserted on one side of the central partition of an ordinary stereoscope, and a square of blue glass on the other. Over each eye-lens is fixed one of Thorp's replicas of Rowland's gratings having 15,000 lines to the inch. Two slits are held in a frame in front of the aperture by which light is usually admitted when using the stereoscope for opaque photographs. The spectra of the first order of these slits appear in the middle of the two glasses. In order to prevent direct admixture of the colours of each spectrum with those of the opposite background, two opaque squares of black material are cemented to each of the coloured glasses, so shaped as to appear of the exact size and position of the spectra. On looking through the stereoscope, two spectra are seen side by side on a field, the colour of which continually oscillates from red through purplish-grey to blue. That connected with the red glass shows little or no red, but a splendid green and an equally splendid violet; while that belonging to the blue glass has the red well developed, the green pale and dingy, and the blue almost absent. The effect of varying the nature of the blue screen is very instructive. With cobalt glass the red is not very

bright, owing probably to the transmission of some red rays by the cobalt glass, but the addition of a film stained with Prussian blue, by which these rays are absorbed, greatly improves the red. On the other hand, a pale yellow film which cuts off the violet causes the violet of the spectrum on the blue ground to stand out brightly, while a purple film brings out the green, which, owing to the green light transmitted by ordinary cobalt glass, is generally a good deal enfeebled. In each case the contrast of the two spectra seen by different eyes is so well marked that the experiment seems likely to be of service in teaching.

The complementary colour to red is shown to consist, not of one simple colour-sensation, but of two at least, namely, green and violet, and in the author's case of blue also. Against a magenta background the complementary colour is seen to be spectral green. But in this case the physical stimulus is complex. On adding to the magenta a yellow glass, to cut out the violet, or using candle light, the violet reappears in the complementary spectrum, while if a blue glass is added instead, the violet vanishes, and red stands out brightly in the spectrum. It may be thus shown that the colour which has green for its complementary is not spectroscopically simple, and since the spectral elements of it have each a different and independent effect upon the spectrum of the complementary colour, the author concludes that the green sensation has no special connection with the red, or indeed with any single colour sensation.

MANCHESTER.

Literary and Philosophical Society, October 2.—Prof. Horace Lamb, F.R.S. (President), in the chair.—Mr. Thomas Thorp described a method of producing a spectrum-like band from a volumetric curve by the use of a photographic camera with a cylindrical lens, and also gave a brief account of the solar eclipse of May last as seen in Algiers.—A paper on plumbism in pottery workers was given by Mr. William Burton, who dealt with the subject from the technical point of view, showing how the plumbism was caused by the inhalation or swallowing of dust containing soluble lead compounds. It was pointed out that the abolition of lead from the glaze was not a practicable remedy, as leadless glazes suited to the conditions of the general run of English pottery are not yet within the reach of the manufacturers. Further, the abolition of lead from the glaze would not affect those cases which arise from the use of enamel or on glaze colour used in the form of dust or of spray, and no one has yet ventured to suggest that the use of lead fluxes for this purpose could be abolished. The existing remedies in the shape of mechanical means for dealing with the dust in such a way that it should neither be swallowed nor inhaled, the periodic medical examination of the workers, and the proposed further safeguards of converting all the lead used into compounds of considerably lower solubility than those now employed, were also treated of. The final opinion of the author was that the combination of all these safeguards would, within a reasonable time, render the operations of glazing and decorating pottery with substances containing lead compounds as free from risk to the operative as it was possible for any industrial occupation to be.

PARIS.

Academy of Sciences, October 8.—M. Maurice Lévy in the chair.—Note on the thirteenth conference of the International Geodetic Association, by M. Bouquet de la Grye. From the reports to the conference it appears that the whole of Europe and North America will be shortly completely covered by a network of triangles. Special observations have been carried out under the direction of the central office in several observatories to determine exactly the line of displacement of the poles. An arc of meridian is being measured in Spitsbergen by Swedish and Russian observers, and Great Britain has commenced the determination of an arc from the Cape to Alexandria, which will join on to the European network through Asia Minor.—Remarks by M. Guyon on the *Connaissance des Temps* for 1903.—Observations of the sun made at the Observatory of Lyons with the Brunner equatorial during the second quarter of 1900, by M. J. Guillaume. The results are summarised in three tables showing the number of sunspots, their distribution in latitude and the distribution of the faculæ in latitude.—The total eclipse of the sun of May 28, 1900, observed at Elche (Spain), by M. Lebeuf. The results of the observations on the times of contact are given.—Researches on the inverse effect of the magnetic field which ought to produce movement in an electrified body, by M. V. Crémieu. The application by Lippmann of the principle of the conservation of energy to the experiments of Rowland on electric convection shows that, reciprocally, magnetic variations ought to produce a movement of electrified bodies placed in the field. The experiments carried out by the author, a detailed description of which, with two diagrams, is given in the paper, show that the expected effect is not produced. The deflection upon the scale should according to the theory have been of the order of 100 to 140 mm. No measurable deflection occurred. Telegraphy without wires with relays. Inconvenience of the Guarini relays, by MM. Guarini and Poncelet.—On iron silicide $SiFe_2$, and on its presence in commercial ferrosilicons, by M. P. Lebeau. A mixture of iron and copper silicide is heated for several hours to the highest temperature of a wind furnace. The mass is extracted with 10 per cent. nitric acid, when a crystalline mass of iron silicide, Fe_2Si, is left behind, which is further purified by successive treatment with soda solution, nitric acid and water.—On a new pyrogenous product from tartaric acid, by M. L. J. Simon. An acid, $C_7H_8O_3$, was obtained, differing both in melting point and solubility from the acid of the same composition previously obtained from the same source by MM. Wislicenus and Stadnicki. Its potassium and silver salts were prepared.—Acetyl derivatives of cellulose and oxycellulose, by MM. Léo Vignon and F. Gerin. Cellulose acetylated by means of acetic anhydride and zinc chloride gives a tetra-acetyl derivative; oxycellulose behaves similarly, and the derivative thus obtained clearly retains its aldehydic functions.—The Albien and Cenomanian of Hainaut, by M. Jules Cornet.

DIARY OF SOCIETIES.

TUESDAY, OCTOBER 23.

ROYAL PHOTOGRAPHIC SOCIETY, at 8.—A Demonstration of the Ozotype Printing Process: Thomas Manly.

FRIDAY, OCTOBER 26.

PHYSICAL SOCIETY, at 5.—Exhibition of Experiments illustrating certain Phenomena of Vision: Dr. Shelford Bidwell, F.R.S.—On the Concentration at the Electrode in a Solution, with special reference to the Liberation of Hydrogen by the Electrolysis of a Mixture of Copper Sulphate and Sulphuric Acid: Dr. J. S. Sand.—Electromotive Force and Osmotic Pressure; Dr. R. A. Lehfeldt.

SATURDAY, OCTOBER 27.

ESSEX FIELD CLUB, at 6.30.—Contributions to the Pleistocene Geology of the Thames Valley. The Grays Thurrock Area, Part I.: Martin A. C. Hinton and A. S. Kennard.

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